RESEARCH PROJECTS

Hypolipidemic and Antioxidant Activity of Theaflvains and Thearubigins from Oolong and Black Tea

- ✍ CHEN Zhenyu ● HUANG Yu (Dept of Physiology)
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

Tea is derived from the leaves of *Camellia sinensis* and is the most popular and widely consumed beverage worldwide. Based on the distinct manufacturing processes, tea can be classified into three main types, namely, green tea, oolong tea and black tea. Green tea is non-fermented tea while black tea generally refers to the fermented one. Oolong tea is the partially fermented product. In green tea, green tea catechins (GTC) remains relatively unchanged compared with the fresh tea leaves, whereas in black tea, they are oxidized and polymerized to the "pigments" called theaflavins (TF) and thearubigins (TR) during fermentation. In contrast, oolong tea contains a mixture of GTC, TF and TR (GTCTFTR). It is known that both green tea and black tea water extracts can reduce serum total cholesterol (TC) and triacylglycerols (TG) in both humans and animals. In addition, many studies have demonstrated that dietary green tea and black tea have strong free-radical scavenging activity both *in vitro* and *in vivo*. When the published data are carefully studied, the researchers found that there is no information on hypolipidemic and antioxidant activity of Chinese oolong tea. To study the relative potency of three types of tea, the present project will examine the hypolipidemic and antioxidant activity of oolong tea water extract compared with that of longjing green tea and qimen black tea water extracts in hamsters fed a high-fat diet. To identify the active ingredients of three types of tea, the hypolipidemic and antioxidant property of isolated TR and TF fractions from qimen black tea, and the GTCTFTR fraction from oolong tea will be also compared with those of isolated GTC fraction from longjing green tea.
(CU00237)

Isolation and Characterization of Plant Ribonucleases

- ✍ FONG Wing Ping
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Ribonucleases (RNases) constitute a class of extensively studied enzymes. RNases are elaborated by bacteria, fungi, plants and animals and classified into several groups based on their structures. Some RNases like bovine seminal RNases possess potentially exploitable biological activities such as antiproliferative activity against tumor cell lines. The intent of the present investigation is to isolate novel RNases from plants including Chinese medicinal materials and seeds, partially sequence the proteins, characterize their RNase activity and examine them for antiproliferative activities. RNases are characterized by thermostability and resistance to certain proteases. This would imply the preservation of RNase activity in Chinese medicinal materials after cooking and passage through the gastrointestinal tract. Chinese medicinal materials are a rich source of pharmacologically active substances and investigations may be rewarding. Crude extracts of the samples selected for the proposed investigation demonstrated potent RNase activity and are worthy of detailed studies.
(BL00721)

School-based Life-long Healthy Eating and Physical Activity Promotion for Hong Kong Primary and Secondary Students

- ✍ GULDAN Georgia Sue ● LAU Wing Chung (Dept of Sports Science & Physical Education)# ● CHIU Ha Ying (University Health Service) ● CHUI Kwan Ho Kenneth# ● CHOW Chun Bong* ● MA, Maggie* ● Union Hospital* ● Ho Sze Ki Winnie* ● Yiu See Ping Nancy* ● Yuen Kar Ngai Robert*
- ❑ 1 August 2000
- ❖ Quality Education Fund, HKSAR Government

Hong Kong's economic advance has been accompanied by the emergence of obesity and physical inactivity among our children. Childhood obesity is a burden ushering short-and long-term severe health consequences because much of the obesity will track into adulthood, where it further exacerbates the high and rising rates of diet-related chronic disease already documented in Hong Kong. The researchers plan to conduct a pilot healthy eating and physical activity campaign during the 2000-2001 academic year with 12 primary and secondary schools. Their goal to strengthen our current curriculum in health and nutrition education to produce students that are all-round successful, including physically fit and healthy, with greater emotional and social readiness to learn. The two key factors predisposing our children to their unhealthy situation are (1) ignorance of the severity of the consequences of this problem amidst widespread food availability, and (2) lack of prevention awareness. Good habit establishment is essential when young. The solutions to this public health problem must focus on prevention rather than on management, and cannot be left to chance. The researchers' pilot campaign's objectives are to:

(1) combat childhood obesity and physical inactivity;
(2) provide sound healthy eating and exercise information and activities that will develop the preventive practical skills to maintain and enhance the health of the Hong Kong primary and secondary school age students throughout their lives;
(3) lay groundwork and develop tested curricular materials for future school-based work among these groups; and
(4) transform and enrich project school's "Health Culture" in these key areas.

(ED20007)

Children's Healthy Lifestyle KAP Research

- ✍ GULDAN Georgia Sue ● HOWDEN Julie* ● KIJBOONCHOO Kallaya* ● POH Bee Koon* ● BARBA Corazon*
- ❑ 1 April 2001
- ❖ Asian Food Information Centre (AFIC)

The seeds of much adult morbidity and mortality are planted in childhood. Healthy lifestyle establishment during childhood should be the goal of all parents, educators, health professionals, and the society in general. In Asia, childhood obesity has emerged in many especially urban areas, including in Hong Kong, in part because children are abandoning their traditional diets and embracing diets, which, in terms of nutrient composition and proportion, are more western-style, while they are also adopting a sedentary lifestyle with little moderate or vigorous physical activity. In order for communities to develop effective and appropriate nutrition and healthy lifestyle promotion activities to combat these problems, the current diet and physical activity knowledge, attitudes, and practices of the children must first be understood and described. This project is a four-city international and cross cultural study undertaken in collaboration with researchers in Bangkok, Kuala Lumpur, and Manila. The researchers' objective is to survey 450 (10-12-year-old) children in each of these four cities in order to obtain comparative information on their knowledge, attitudes, and practices (KAP) regarding eating habits and physical activity.

(BL20011)

Induction of UDP-glucuronyltransferase and Its Regulation in Rats by Licorice Extracts

- ✍ HO Wing Shing John
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

UDP-glucuronyltransferase is an important enzyme in the detoxification reaction in the liver. The enzyme can be induced by chemicals and drugs. Different isozymes of UDP 1A family have been identified. However, its expression and inducibility are not fully understood. The researchers' previous study using human hepatocellular carcinoma and hepatoblastoma cell lines showed that the enzyme can be significantly enhanced by hepato-protective herbal medicine. The earlier study indicated that some of the genes have been assigned to UDP-glucuronyltransferase induction, the roles they play in the enzyme expression have yet to be elucidated. An approach to get an understanding of these roles is to investigate the gene expression profiles by comparing patterns of expression *in vivo* conditions. In this study, it is planned to use specific rats which are deficient in these genes associated with UDP-transferase expression. Rats are sacrificed after treatment for a period of time. The enzyme function will be measured and the mRNA level will be determined using RT-PCR, RNase protection assays. Northern blot analysis will also be carried out to confirm the results. Expression of UDP-transferase is to be studied after rats are treated with licorice extracts for different periods of time. The expression of UDP-transferase messengers will be examined. An *in vivo* expression system coupled with the RT-PCR methodology will be followed according to the researchers' established methodology. The study will provide useful information on genes and the proteins they encode. The results will be compared with that of *in vitro* study. The study will allow us to identify the gene products and to get an understanding of function, regulation and its transcriptional control. The methodology will be valuable tools for screening other hepato-protective herbal medicines for enhancement of enzyme functions. The study will have a wide range of applications, including investigating normal biological and disease processes, profiling differential gene expression, and discovering potential therapeutic and diagnostic drug targets.

(BL00746)

Identification of Peroxisome Proliferator-activated Receptor-alpha (PPARalpha)-dependent Genes Involved in Hepatic Lipid Metabolism

- ✍ LEE Sau Tuen Susanna
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

Recent evidence indicates that the peroxisome proliferator-activated receptor- α (PPAR α), a nuclear hormone receptor and a ligand-dependent transcription factor, is involved in the regulation of lipid homeostasis during energy deprivation such as that associated with diabetes and fasting. A prominent feature of the energy-metabolic response

to energy deprivation includes a switch to reliance on fatty acids and ketone bodies for energy production and an augmentation in the capacity for mitochondrial fatty acid oxidation in tissues with high oxidative energy demands such as liver. However, the underlying mechanisms by which PPAR α mediates these physiologic responses are still not clear. Studies with the PPAR α-null mice demonstrate that PPAR α controls the expression of some genes related to fatty acid metabolism in the liver during diabetes and fasting. However, it is not clear how the complex network of PPAR α-dependent signaling pathways in the liver that operate during energy deprivation and stimulate fatty acid oxidation to form substrates that can be metabolized by other tissues. Identification of such PPAR α-dependent gene(s) might provide insight on how PPAR α regulates and coordinates a whole network of biological responses to fatty acid signaling molecules during energy deprivation. The aim of the proposed research is to identify the spectrum of PPAR α-dependent gene(s) involved in regulation of hepatic lipid homeostasis during fasting using fluorescent differential display techniques. The significance of the fasting-inducible adaptive response for cellular fatty acid utilization is underscored by the dramatic phenotype of human inborn errors in mitochondrial fatty acid oxidation enzymes. Children affected with genetically inherited defects in mitochondrial fatty acid oxidation enzymes typically are asymptomatic under normal feeding conditions. However, short-term fasting, such as that associated with an infectious illness, results in hypoketonemia and liver dysfunction. Understanding the PPAR α-dependent signaling pathways involve in fatty acid oxidation during energy deprivation might provide insight for the endogenous physiological functions of the PPAR α and for the treatment of inherited and acquired human fatty acid oxidation disorders.
(CU00241)

Crystallisation and Structural Study of EcohK31I DNA Methylase

- ✍ SHAW Pang Chui
- ❑ 2 January 2001
- ❖ CUHK Mainline Research Scheme

Cytosine methylase is an enzyme that catalyzes the transfer of a methyl-group from S-adenosyl-L-methioine to cytosine residues in the target DNA molecules. Recently, the researchers have discovered a novel EcoHK31I cytosine methylase from a clinical Escherichia coli strain. This methylase contains two polypeptides, α and β instead of the usual single polypeptide in the other methylases. Characterisation of this novel system will provide insight on the flexibility of motif organization in this family of proteins and enrich our understanding on protein-protein and protein-DNA interactions. The researchers have used molecular and biochemical methods to investigate how the two polypeptides in this methylase interact between themselves and with the DNA substrate. However, to have an ultimate understanding of its function, they have to obtain the three-dimensional structure of this methylase. The principal investigator thus proposes to purify and grow crystals in Hong Kong and to collaborate with Dr. Roger Williams at MRC Laboratory of Molecular Biology, Cambridge, UK, to elucidate the structure of EcoHK31I methylase by X-ray crystallography. Experiences gained by the principal investigator will not only help to further understand this novel DNA methylase but also strengthen structural biology research in The Chinese University of Hong Kong.
(BL20010)

Second Messenger Mediating the Interaction Between Tumor Necrosis Factor-α and β-adrenergic Mechanism in C6 Glioma Cells

- ✍ TSANG David Sau Cheuk
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Damage to the central nervous system (CNS) elicits complex responses which subsequently lead to glial scar formation, and this process impedes neuron regeneration. Among the responses, tumor necrosis factor-α (TNF) level is greatly elevated, and that inhibitors of TNF gene expression significantly imporves the outcome of brain injury suggesting that elevated TNF level mediated pathological events following brain injury. TNF is a multifunctional cytokine mainly secreted by astrocytes that has a wide range of biological effects, including proliferation, cytotoxicity, inflammation, and immunomodulation. Recently, it was reported that β-adrenergic blockade also reduced glial scar formation. These together suggest that TNF and β-adrenergic mechanism are closely related in glial scar formation following brain injury. However, the relationship between these two processes is still unclear, and the aim of this project is to elucidate the second messenger mediating the elevated TNF level and β-adrenergic mechanism in C6 glioma cells. C6 Glioma cells will be used as they have many properties similar to astrocytes and that they are much easier to culture. The long-term goal of this study is to find a more effective treatment for brain injury.
(BL00734)

Antiviral Activities of γ-interferon

✍ WANG Jun
❑ 1 August 2000
❖ GeneHarbor Technologies Inc.

This study probes new way of improving γ-interferon activities.
(BL20001)

Structure-function of a Novel RNA-binding Motif-structure Determination of a Ribosomal Protein L30e From Thermococcus celer by Multi-dimensional NMR Spectroscopy

✍ WONG Kam Bo
❑ 1 November 2000
❖ Research Grants Council (Earmarked Grants)

Ribosomal protein L30e is a protein component of the 50S ribosome subunit. It has a RNA-binding motif that are conserved in different protein families from prokaryotic, eukaryotic and archaeal genomes. The homologous proteins are involved in various cellular functions: translation termination, ribosome modification, ribosomal RNA processing and cell cycle arrest. This conserved RNA-binding motif, therefore, is an excellent model to study RNA-protein interaction. The researchers propose to study the structure-function of this RNA-binding motif by determination of the three dimensional structure of the ribosomal protein L30e from *Thermococcus celer* by multi-dimensional NMR spectroscopy. They will also study the RNA-protein interactions by molecular and biochemical techniques. High resolution structure obtained will contribute to a reconstruction of an atomic model of the whole ribosome. It will also provide structure models for an ongoing project of structure-function of this RNA-binding motif. Results obtained on L30e will be applied to other homologous proteins to extend our knowledge of the biological functions of these proteins.
(CU00243)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1997-98	Investigation of Mechanisms of Cholesterol-Lowering Effect of Green Tea Epicatechin Isomers (CU97307) ✍ CHEN Zhenyu ● FONG Wing Ping
1998-99	Healthy Eating Movements (BL98036) ✍ GULDAN Georgia Sue ● CHAN, Vivian* ● WONG, Christine* ● TSANG, C. Y. Chester* ● FUNG, Y. K. Anne* ● MA, Maggie* ● HO, S. K. Winnie*
1997-98	Preclinical and Clinical Validation of Fructus Crataegi and Green Tea in Lowering Blood Lipids (BL97006) ✍ HO Walter K. K. ● CRITCHLEY Julian A J H (Dept of Medicine & Therapeutics)# ● MARK Tony* ● TOMLINSON Brian (Dept of Medicine & Therapeutics) ● CHEN Zhenyu ● WONG Nai Ching Henry (Dept of Chemistry) ● WAN Chi Cheong David (Biochemistry) ● LAM Wai Kei Christopher (Dept of Chemical Pathology) ● ZHU Min (School of Pharmacy)#
1998-99	Evaluation of Major Phytochemical Constituents in Radix Pseudostellariae and Glycyrrhizae in Detoxification and Anticancer Activity (BL98028) ✍ HO Wing Shing John ● KWOK Tim Tak (Biochemistry) ● LEE Hung Kay (Dept of Chemistry)
1999-00	Cellular Expression of UDP-glucuronyltransferase and Its Regulation by Aromatic Hydrocarbons (BL99018) ✍ HO Wing Shing John
1997-98	Production of Transgenic Mice Lacking the Fatty Acid-Activated Receptor: An Animal Model to Study Adipose Cell Differentiation and Obesity (CU97318) ✍ LEE Sau Tuen Susanna ● CHAN Wood Yee (Dept of Anatomy) ● CHEUNG Wing Tai (Biochemistry)
1998-99	Isolation of Marker Genes for Prediction of Peroxisome Proliferator Chemical-Induced Hepatocarcinogenesis (BL98009) ✍ LEE Sau Tuen Susanna
1999-00	Identification of Peroxisome Proliferator-activated Receptor-a (PPARa)-dependent Genes Involved in Peroxisome Proliferator-induced Hepatomegaly and Hepatocarcinogenesis (CU99157) ✍ LEE Sau Tuen Susanna ● CHAN Wood Yee (Dept of Anatomy)
1999-00	Studies on the Immunomodulatory and Anti-tumour Activities of Green Tea Catechins (CU99160) ✍ LEUNG Kwok Nam ● CHEN Zhenyu
1998-99	Screening and Characterisation of Proteins that Interact with Trichosanthin (CU98039) ✍ SHAW Pang Chui

1998-99 Conservation of Endangered Species Used in Chinese Medicine through Identification by Molecular and Chemical Approaches (BL98032C)
✍ SHAW Pang Chui ● WANG Jun ● BUT Pui Hay Paul (Dept of Biology)

1999-00 Structure-function Relationship Study of M.EcoHK31I, a C5-cytosine Methyltransferase with Two Polypeptides (CU99177)
✍ SHAW Pang Chui ● LEE Kai Fai*

1999-00 Mitotic Gene Conversion in Asexual Diploid Candida albicans (CU99158)
✍ WANG Jun

1999-00 DNA Fingerprinting Technology for Detection of Genetically Modified Organisms and Identification of Chinese Population (BL99029)
✍ WANG Jun

1999-00 Protein-protein Interactions of Hepatitis B Virus X Antigen – A Structural Approach (BL99019)
✍ WONG Kam Bo

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<P004044> **LEUNG Yuet Kin and HO John.** "Effects of Licorice on the Expression of UGT1A Isozymes in Rat Hepatoma Cells". *The Federation of American Societies for Experimental Biology* vol.14 no.8, p.A1525. USA: Biology Department, The Chinese University of Hong Kong, 2000.05.11.

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see also <P000110>, <P002100>, <P002253>, <P002352>, <P002410>, <P002413>, <P002541>, <P002542>, <P002950>, <P002964>, <P003137>, <P003147>, <P003367>, <P003414>, <P003979>, <P003980>, <P006585>, <P009916>, <P010245>, <P010410>, <P010618>, <P010691>, <P010728>, <P011148>, <P011570>, <P011694>, <P019071>, <P019285>, <P994670>

RESEARCH PROJECTS

Resource Assessment of Marine Alga *Hypnea charoides* in Hong Kong

- ✍ ANG Put Jr.
- ❑ 1 April 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Algae are under-utilized resources in Hong Kong. Preliminary studies conducted by the research team at the Biology Department of The Chinese University of Hong Kong indicated the potentials of many Hong Kong algal species as anti-tumor, antiviral, anti-coagulant and hepatoprotective agents as well as nutraceutical food. One of the most promising algae is the red alga *Hypnea charoides*, which is abundant in Hong Kong coastal waters. This research aims to understand the general biology and distribution of this algal species throughout Hong Kong waters and assess the harvestable stock available. Detailed studies on the phenology, reproductive seasonality and recruitment of populations of this species will be carried out in selected sites around Hong Kong, including Tung Ping Chau, Yan Chau Tung, Sai Kung and the east coast of Hong Kong Island.
(BL00425)

An Investigation of the Physiological Functions of Different Laccase Components Produced by the Edible Mushroom, Pleurotus Sajor-caju

- ✍ BUSWELL John Anthony ● GE Wei
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Colonisation of the lignocellulosic substrate by mushroom fungi and subsequent production of the mushroom fruit body is dependent upon their ability to synthesise and secrete the relevant enzymes which (1) degrade the individual polymeric constituents (cellulose, hemicellulose, lignin), (2) are involved in the development of the mushroom fruit body, and (3) protect the fungal hyphae from the toxic effects of phenolic compounds present in the growth substrate. The proposed research will focus on one such enzyme, laccase, at least five forms of which are produced by *Pleurotus (P.) sajor-caju.* Using a combination of biochemical and molecular biological strategies, the researchers intend in this investigation to (1) purify and partial characterise the different laccase components produced in both submerged and solid-state cultures of *P. sajor-caju,* (2) identify, clone and sequence the corresponding laccase genes, and (3) determine the gene regulation patterns during substrate utilisation and fruit body morphogenesis, and in response to the presence of toxic phenols. The long-term value and significance of the research proposed lies in the potential to enhance the bioconversion of waste lignocellulose by *P. sajor-caju*, thereby increasing the biological efficiency and improving mushroom yields, and to facilitate the development of appropriate DNA technology for generating improved strains of *P. sajor-caju* and other edible mushrooms.
(CU00260)

Nutritional Evaluation of Edible Mushrooms

- ✍ CHEUNG Chi Keung Peter ● HUANG Nian Lai*
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Edible fungi or mushroom is an ideal health food due to its high fiber and protein as well as low fat contents. Mushrooms are also rich in microelements including a number of functional minerals and vitamins. The common edible form of most mushrooms is their freshly fruiting bodies. Among the various edible mushrooms, there is a large number of less common ones that are not utilized but have potential to become human food. This project aims at evaluating the nutritional values of some less common edible mushrooms by both chemical and biological methods. A comparison will also be made with the different forms of mushroom including its fruiting body, mycelium and sclerotium. A toxicological study of the mushroom will also be conducted.
(BL00678)

Molecular, Genetical and Physiological Characterization of Hong Kong Lingzhi, *Ganoderma Lucidum*

- ✍ CHIU Siu Wai
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Lingzhi is a traditional Chinese medicine. Commercially artificial cultivation of lingzhi is practised in Hong Kong and widely throughout China including Taiwan. Eleven species belonging to the *Ganoderma lucidum* complex were described growing wild in Hong Kong, and many species in *Ganoderma lucidum* complex are pathogens to various woody and crop plants worldwide. Identification based on conventional morphological and colony characters for discriminating *Ganoderma* species is inconclusive and sometimes unreliable. If the potential of this respected remedy and sustainable forest management for this pathogen are to be properly realized, it is crucial that methods of reliable

identification are established. It is proposed to use an integrated approach of conventional technique (somatic and mating incompatibility) and biotechnological tools (protoplasting technique, polymerase chain reaction and DNA sequencing) to examine the biodiversity of Hong Kong lingzhi. Fruiting bodies of wild *Ganoderma lucidum* will be collected from various reserve areas in Hong Kong for tissue isolation. Protoplast technology will be performed to recover monokaryons. Freeze-dried fruiting bodies will be used directly for DNA extraction. Thus the biodiversity of lingzhi in Hong Kong will be revealed. More importantly, the established integrated characterization system will serve for the systematic of *Ganoderma*, which at present suffers from severe misidentification and misnaming. The Chinese *Ganoderma* suffers the most.
(BL00395)

Isolation, Characterization, and Molecular Cloning of the Androgenic Hormone of the Mud Crab Scylla spp.: Development of Monosex Crab Aquaculture

- ✍ CHU Ka Hou ● KEENAN Clive P* ● SUN Piera S*
- ❑ 1 October 2000
- ❖ Research Grants Council (Earmarked Grants)

Aquaculture of the mud crab *Scylla* spp. is expanding in many Asian countries. Male crabs attain a bigger size than females, but females with ripe ovaries command a much higher market price in Chinese markets. Thus in different countries either all-male or all-female culture is more profitable than mixed sex culture. Mud crab culture will thus benefit greatly from sex control biotechnology. The proposed study represents a first step towards the development of this technology. It is well documented that the androgenic hormone controls male sexual differentiation in crustaceans. The project aims at the isolation, characterization, and cloning of the androgenic hormone from the mud crab using state-of-the-art molecular biology techniques. The biological activity of the recombinant hormone will then be confirmed by bioassay. The recombinant hormone produced in this study will be used in subsequent investigations on breeding schemes and gene transfer for the production of progeny of the same sex. The ultimate goal is the development of commercial monosex crab culture in China and other Asian countries.
(CU00254)

Morphological and Molecular Variations Among Populations of the Brown Alga *Sargassum hemiphylum*

- ✍ CHU Ka Hou ● ANG Put Jr.
- ❑ 1 April 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

The genus *Sargassum* (Phaeophyta) has over 400 species and is taxonomically one of the most confusing groups of brown algae. The taxonomic complexity in this genus is due to the high level of differentiation and large variation in morphology not just between species but also among populations of the same species. An understanding of the extent of population variations can help to clarify the basis for species identification. In the present study, the economically important species *Sargassum hemiphyllum* will be examined for their population variations. Various populations will be sampled along the coast of western Pacific Ocean. Techniques used to evaluate population variations include morphological measurements and DNA analysis based on the RUBISO gene in chloroplast DNA. The morphological and molecular data will be analyzed to elucidate the genetic relationships among different populations. Results of the proposed study will not only be useful in evaluating the current taxonomy of *Sargassum hemiphyllum* but will also provide information on the biogeography and probable evolutionary history of this species.
(BL00537)

Revegetation of Newly Restored Landfills: Site Environmental Conditions and the Role of Native Species

- ✍ CHU Lee Man
- ❑ 1 November 2000
- ❖ Research Grants Council (Earmarked Grants)

The revegetation of local closed landfills depends heavily on the use of exotic species, but there is an increasing need to plant more natives so as to enhance species diversity and wildlife conservation. The researchers propose to carry out a research project on the environmental conditions of the recently restored landfills and the role and establishment of native species on these landfills. The objectives of the study are:

(1) to examine the soil properties, particularly the nutrient status and water supplying capacity, and the environmental conditions of the soil cover on restored landfills;
(2) to monitor *in situ* the growth of planted species, in particular native species; and
(3) to screen natives which are adaptive to the conditions on restored landfills.

Results obtained can aid in understanding the environmental problems on restored landfills, which are useful in selecting suitable native species, maintaining good vegetation growth and creating diverse communities on future closed sites such as

the three big strategic landfills which will be exhausted in the next one to two decades.
(CU00250)

The Use of Landfill Leachate as Irrigation Water for Plant Growth

- ✍ CHU Lee Man
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Landfill leachate is considered a serious threat of contamination to our environment. With tightened pollution control, the discharge of leachate without any treatment is no longer acceptable. However, landfill leachate is toxic and is not always amenable to biological degradation. On the other hand, it contains high level of ammoniacal-nitrogen, which is a valuable source of nitrogen for plant growth. If properly done, spraying leachate as irrigation water on closed landfills can serve to relieve the stressful conditions of nutrient deficiency and drought. This project aims to investigate the effects of landfill leachate on the growth and performance of trees growing on landfill soil cover, and to assess the feasibility of using leachate as an irrigation source. The soil profile of important nutrient elements in leachate will be examined at the end of the irrigation period to provide information on their fate and vertical movement in the soil column after surface application.
(BL00501)

Repulsive Odor in Chaw Tofu

- ✍ CHUNG Hau Yin
- ❑ 1 May 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Couple of court cases in Hong Kong highlighted the concerns of odorous foods and its impact on the environment. The owners of two unrelated chaw-tofu stores were fined for emitting strong odor and oil fume during their food preparation. Chaw-tofu is a popular traditional fermented soy-based food giving out strong unique repulsive odors when deep-frying, but little during consumption. Some consumers crave for it for its odor but some complaint about it, particularly from those who are under constant irritation. After the local verdict, a handful of chaw-tofu stands and stores exist. This odorous food may eventually be eliminated in any modern society. Regretfully, there has been limited documentation about their odors and their origins even though those are their unique features. Therefore, the objective of this research is to determine the components responsible for such unique odor so that food scientists and product developers may improve the product quality and modify unpleasant cooking process of this food.
(BL00327)

Cloning and Expression of a Gene Enconding Sj16, an Anti-inflammatory Protein from *Schistosoma japonicum*

- ✍ FUNG Ming Chiu
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

The schistosomulae of the *Schistosoma japonicum* can penetrate and migrate through the skin and remain in the skin for 72 hours without eliciting any anti-inflammatory response. In the study of *Schistosoma mansoni, its* anti-inflammatory activity is associated with a excretory/secretory protein of molecular mass 16.8kDa (Sm16). Under *in vitro* conditions, Sm16 induce the production of the anti-inflammatory cytokine IL-1ra from the human keratinocytes, thus down regulating IL-1a expression in human keratinocytes, prevented lymphoproliferation, and suppressed ICAM-1 expression on endothelial cells. However, the anti-inflammatory activities of *S.japonicum* have not been studied. In this study, degenerated primers will be used to amplify the Sj16 by PCR. The cloning of a gene enconding Sj16 would be much helpful for the structural and functional studies of Sj16 as well as the development of vaccine for the *S.japonicum*.
(BL00473)

Gonadotropin Regulation of the Expression of Activin and Its Receptors in the Zebrafish Ovary

- ✍ GE Wei
- ❑ 1 April 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Activin is a growth factor that plays important roles in vertebrate reproduction. Using zebrafish, *Danio rerio*, as a model, the researchers have demonstrated that both activin and its type II receptor are expressed in the zebrafish ovary, suggesting local paracrine roles for activin in the ovarian functions. This has been further substantiated by their findings that recombinant goldfish and human activin A and B promote the development of the oocyte maturational competence and stimulate the final oocyte maturation. Furthermore, their evidence points to the possibility that the local ovarian activin system may play a critical role in mediating the effect of pituitary gonadotropin in the event of oocyte maturation. To test this hypothesis, the researchers propose to investigate if the expression of activin and type II

receptor is up-regulated by gonadotropin in the present study. Briefly, they will adopt an in vitro culture of zebrafish ovarian follicle cells, which is well established in their laboratory. The cells will be challenged by gonadotropin (human chorionic gonadotropin, hCG) for different times at different doses. Total RNA will be extracted from the cells at the end of treatment and subject to analysis for the expression of activin and its type II receptor. Considering that cAMP is the major second messenger that mediates the action of gonadotropin, the researchers will also examine the effects of different drugs that manipulate the cAMP pathway, including cAMP analogs, IBMX and forskolin.
(BL00820)

Compartmentation of Proteins in the Protein Storage Vacuole of Plant Cells

- ✍ JIANG Liwen
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

A major difference between plant cells versus yeast and animal cells is that plant cells store many type of metabolic products (including proteins) in vacuoles. The protein storage vacuoles (PSVs) that store proteins are functionally distinct from the plant cell's lytic vacuole(LV). PSV in most seeds contains three distinct subcompartments: the matrix, the crystalloid, and the globoid. Recently, it has become evidence that the PSV is a compound organelle containing membrane-bound subcompartments with different functions (Jiang et al., 2000, J. Cell Biol. 150:755-769). Here the researchers propose to characterize the PSV, a compound organelle, using molecular, biochemical and immunocytochemical approaches. They will study mechanisms by which PSV subcompartment assembly, by testing the hypothesis that the globoid functions as a lytic vacuole within PSV upon seed germination. They will also test the hypothesis that two integral membrane proteins, RMR (Ring H2 Membrane Receptor-like protein) and DIP (Dark Intrinsic Protein), play important roles in the formation and organization of the crystalloid within the PSV. Results from these studies should enhance our knowledge in understanding mechanism by which protein compartmentation in the PSV. Such research is also important in plant biotechnology in which PSV is the primary target site for stable accumulation of value-added proteins in transgenic plants.
(BL00823)

Isolation and Differential Expression Analysis of Hydrophobin Genes of Shitake Mushroom *Lentinula edodes*

- ✍ KWAN Hoi Shan
- ❑ 1 April 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

The researchers' laboratory aims to elucidate the molecular aspects of fruit body development, the most important and conspicuous developmental process in the life cycle of the cultivated mushroom *Lentinula edodes*. An understanding of the molecular aspects of the fruiting process would allow the mushroom biologists to design rational mushroom breeding programmes using molecular tools. During the initiation and development of the mushroom, a group of proteins, hydrophobins is produced to form a coat on the mushroom. These proteins protect the mushroom from dehydration when it emerges into the air. Specific hydrophobins may play specific roles at different developmental stages and in different tissues. In order to study the roles of these hydrophobins, it is necessary to isolate the encoding genes and establish their expression pattern during mushroom development.
(BL00642)

Sink-Source Relationship During Seed Development in Arabidopsis Thaliana - Molecular Regulation of Aspartate Family Amino Acids

- ✍ LAM Hon Ming ● SUN Sai Ming Samuel
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

Seed proteins, especially from cereals and legumes, are the major source of dietary essential amino acids. Aspartate family amino acids (including the essential amino acids methionine, lysine, threonine, and isoleucine) are particularly important since methionine is deficient in legumes while lysine and threonine are limited in cereals. Previous attempts to manipulate the aspartate family amino acids levels in seeds using feedback insensitive rate-determining enzymes were not effective. One possible improvement to this approach is to provide effective sinks to trap the accumulated free amino acids generated by enhanced sources. Moreover, while enzymatic end product feedback inhibition of aspartate family amino acids was studied extensively, the knowledge of control at the gene expression levels (which is important for integration of complex intrinsic signals and environmental stimuli and thus important for seed quality control) are incomplete. Using the available tools developed jointly by the Principle Investigator and co-Principle Investigator, the objectives of this project are:

(1) to study the effect of sink-source relationship on the molecular regulation of genes encoding key enzymes for the biosynthesis of aspartate family amino acids during seed development; and

(2) to enhance methionine and lysine contents of plants by providing a combination of effective sinks and enhanced sources.

(CU00263)

Cloning of Floral Homeotic MADS-box Genes in the Short-day Dicot, *Glycine max*

- ✍ LAM Hon Ming ● HAN Tianfu*
- ❑ 1 April 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

MADS-box genes represent a large multigene family of transcription factors in plants, animals and fungi. In plants, MADS-box genes are involved in different developmental processes, in particular, as key regulators in controlling floral meristem identity as well as organ identity within the flower. In the long-day dicotyledonous model plant, *Arabidopsis thaliana*, more than forty MADS-box genes were identified, including the floral organ identity genes *API* (*APETALAI*), *AP3 (APETALA3*), *PI* (*PISTILLATA*) and *AG(AGAMOUS)*, which play pivotal roles in specifying organ primordia to form sepals, petals, stamens or carpels. In the short-day monocotylydenous crop plants, rice (*Oryza sativa*) and maize (*Zea mays*), over thirty MADS-box genes have been reported. However, little information is available for the short-day dicot, *Glycine max*.

Soybean (*G. max*) is an important annual crop plant that is rich in protein and oil. Its sensitivity towards photoperiod for flowering has limited its productivity. Previous studies on flowering of soybean mainly focused on how the plant responded to this and other environmental cues at the physiological level. To better manipulate this crop plant to enhance growth and breeding efficiency, a better understanding of its flowering mechanism at the molecular level is indispensable. Cloning of MADS-box genes from soybean is a necessary first step to achieve this end.

Plant MADS-box genes are characterized by the M-(MADS), I-(intervening, also called linker, L), K-(keratin) and C-(C-terminal) domains. The MADS domain of about sixty amino acids is highly conserved. This allows the design of family-specific primers for the isolation of the MADS-box gene family members. Recently, a cDNA library for mature flowers of soybean was constructed in the researchers' laboratory. This, together with the MADS-box-specific primers/probes, enables the researchers to isolate floral homeotic MADS-box genes from soybean either by PCR or by hybridization. For the PCR approach, one MADS-box family-specific primer and one universal primer from the vector can be used to amplify the cDNA fragments 5' or 3' of the MADS-box, depending on the direction of the primers used. Alternatively, direct hybridization to the cDNA library can be performed using the homologues/orthologues from *Arabidopsis thaliana* as probes.

(BL00806)

Flow Cytometric Studies on Anticancer and Immunomodulatory Activities of Microalgal DHA and EPA

- ✍ OOI Vincent Eng Choon ● CHIU Chi Ming Lawrence
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Fish oils, particularly those that are rich in docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), have long been considered as nutraceuticals with anticancer and therapeutic potentials. However, there are several drawbacks in the satisfactory exploitation of these substances. Recently, cultured microalgae have been developed as an alternative source for DHA- and EPA-rich nutraceuticals which are free from environmental pollutants and devoid of other fatty acids contamination. Nevertheless, studies on anticancer and immunomodulatory properties of microalgal oils are somehow only limited. In the present study, various novel flow cytometric methods are used to investigate the anticancer effects and mechanisms of DHA-enriched microalgal oil derived from *Crypthecodinium cohnii* and EPA-enriched microalgal oil from *Nitzschia alba* respectively against human leukemic HL-60 and K-562 cells. The researchers will examine in details the effects of these microalgal oils on cell-cycle progression and programmed cell death of cancer cells, as well as their mechanistic actions on the regulatory cyclins and bcl-2/bax expressions. Furthermore, they will also determine the *in vivo* immunological actions of these microalgal oils on T-cell CD4/CD8 ratio and cytokine expression thoroughly by immunophenotyping and cytokine determination techniques of flow cytometry and RT-PCR respectively. The researchers believe that this study will provide scientific information for better understanding and solid foundation for potential development of microalgal oils as dietary supplements with proven anticancer and other therapeutic properties.

(BL00540)

Development of a Rapid Toxicity Screening Test Based on the Filtering Behaviour of the Green Mussel *Perna viridis*

- ✍ WONG Chong Kim
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

A rapid toxicity screening test based on the filtering behaviour of the green mussel *P. viridis* will be developed. The test is based on the suppression of filtering activity of *P. viridis* after a 4-h exposure period to pollutants. Filtering rates will be calculated rapidly and accurately from fluorometrically determined decrease in chlorophyll-a concentration. The effect of temperature and salinity on the sensitivity of the test will be evaluated. The test will be compared with the Microtox® test for assessing the toxicity of effluent and marine sediments.
(BL00330)

Water Quality Monitoring in Marine Park and Marine Reserve

- ✍ WONG Chong Kim ● CHU Lee Man ● WONG Po Keung ● CHU Ka Hou
- ❑ 1 June 2001
- ❖ Agriculture, Fisheries & Conservation Dept, HKSAR Government

To conduct water quality monitoring at existing marine parks, marine reserve and the proposed marine park at Tung Ping Chau. Physico-chemical and biological water quality parameters will be analyzed in the field and laboratory. Data will be analyzed to detect annual trends in water quality parameters and evaluate the rate of compliance with water quality objectives. Results from the study will be used by the Agriculture, Fisheries and Conservation Department to further improve management, visitor services and environmental monitoring in marine parks and marine reserve.
(BL00633)

Removal of Pentachlorophenol by Adsorption by Chitin from Shrimp Shell Waste

- ✍ WONG Po Keung
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Pentachlorophenol (PCP) is a colorless crystal but with strong odor under high temperature. It has been commonly used as a wood preservative and precursor of pesticides. It is toxic, mutagenic and even carcinogenic to living organisms. Its toxicity is due to its inhibition of cellular enzyme such as ATPase in living organisms. Its stable and toxic properties make PCP one of the priority pollutants. However, due to the uncontrolled disposal and massive use of PCP as water disinfectant and pesticides, relatively large amount of PCP remains in terrestrial and especially aquatic environments. Biological degradation is too slow to completely and timely detoxify PCP, other methods include physical and chemical treatments have been used and no satisfactory results have been obtained.
In the present study, chitin prepared from shrimp shell waste will be used to rapidly remove PCP from aqueous solution. The PCP-loaded chitin will be further degraded and detoxified by photocatalytic oxidation (PCO). The chemistry and toxicology of the PCO degradation products of PCP and chitin will be determined. The results obtained will form a base for the development of a pilot-scale reactor to rapid and efficient degrade and detoxify PCP in aquatic environmental samples.
(BL00518)

The Effects of Narciclasine on the Greening of Etiolated Wheat Leaves

- ✍ WONG Yum Shing
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Narciclasine is a plant alkaloid isolated from the bulb of *Narcissus tazetta.* It is a potent growth inhibitor which exhibits a wide range of inhibitory effects on different plant growth and developmental processes. This alkaloid has also been shown to have antiviral and antimitotic activities. The physiological role of narciclasine in the narcissus plant is not known. It is suggested to be a chemical defense compound or an allelopathic substance. In this project, the effects of narciclasine on chlorophyll biosynthesis, light-harvesting complex II formation and chloroplast development during greening of etiolated wheat leaves will be investigated.
(BL00656)

Modulation of Gill Na^+-K^+-ATPhase Expression by Salinity and Hormonal Factors in the Sea Bream, Sparus sarba

- ✍ WOO Norman Ying Shiu
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

The sea bream (S*parus sarba*) exhibits remarkable euryhalinity in that it can maintain ionic and osmotic homeostasis throughout a wide range of ambient salinities (0-50 ppt). The principal site for maintaining ionic/osmotic homeostasis in marine teleosts is gill sodium-potassium activated adenosine triphosphatase (Na^+-K^+-ATPase), an ionomotive enzyme which is thought to be located at the basolateral membrane of the gill chloride cell. However, this has not been adequately tested in marine fish especially with regard to a presumptive role of the enzyme in both ion extrusion (in hyperosmotic media) and ion uptake (in hyposmotic media). The present work will address this void by

assessing the role played by gill Na^+-K^+-ATPase in the overall osmoregulatory strategy of the sea bream in different salinities. The researchers will evaluate gill Na^+-K^+-ATPase status at the molecular level by studying expression at the subunit mRNA, subunit protein, and enzyme activity levels. The roles of the osmoregulatory hormones (cortisol, prolactin, and growth hormone) in modulating sea bream Na^+-K^+-ATPase expression will also be assessed. The operation of Na^+-K^+-ATPase as an ion pump requires considerable expenditure of metabolic energy in the form of ATP and therefore maipulating Na^+-K^+-ATPase under different salinities/hormonal status offers an avenue for minimizing the metabolic cost of osmoregulation. In addition, a theoretical environment of least cortisol (catabolic) and high growth hormone (anabolic) will be ideal for fish culture and this corollary can be addressed. This project will enable a better understanding of the basic mechanisms underlying the extreme euryhalinity of a marine teleost and will lay the background necessary for the development of culture strategies associated with the optimization of salinity and endocrine regimes.
(CU00252)

An Investigation into the Effects of Growth Hormone, Prolactin and Cortisol on Branchial HSP90, HSP70 and HSP60 Expression in Silver Sea Bream

- ✍ WOO Norman Ying Shiu ● DEANE Eddie Edward
- ❑ 1 March 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Several forms of stress proteins (heat shock proteins, HSPs such as HSP60, HSP70 and HSP90) exist in marine fish species. Whereas there is considerable evidence that HSP70 is inducible upon exposure to heat stress, it is not clear whether HSP60 or HSP90 are also heat-inducible. The present work will attempt to delineate whether high temperature stress will induce the expression of all three forms of HSP in the sea bream. Salinity adaptation in fish is thought to be mediated via the various osmoregulatory hormones such as cortisol, growth hormone and prolactin. This proposed work will also study whether these osmoregulatory hormones will also induce the expression of HSPs in the main organ of osmoregulation in fish (the gills). HSP expression will be studied at both the mRNA and protein levels and will combine the use of both *in vivo* and *in vitro* systems. The proposed study will provide new information on the role of hormones and their regulatory effects on HSP expression in fish.
(BL00859)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1998-99	Pharmaceutical, Nutritional and Biotechnological Application of Seaweed Resources in Hong Kong (BL98027) ✍ ANG Put Jr. ● CHEUNG Chi Keung Peter ● CHUNG Hau Yin ● OOI Vincent Eng Choon
1999-00	Reproductive Ecology of Sargassum Siliquastrum in Ping Chau, Hong Kong (BL99021) ✍ ANG Put Jr.
1990-91	Elucidation of Biochemical Events Regulating Secondary Metabolism in the Ligninolytic Fungus *Phanerochaete chrysosporium* (BP91015) ✍ BUSWELL John Anthony
1991-92	Enzymic Evaluation of Starch Availability in Foodstuffs (BP92007) ✍ BUSWELL John Anthony
1997-98	Production and Distribution of Cellulolytic Enzymes in the Edible Straw Mushroom, *Volvariella volvacea*, during Substrate Colonisation and Fruit Body Morphogenesis (CU97329) ✍ BUSWELL John Anthony
1998-99	Isolation, Identification and Biotechnological Characterisation of Hyperthermophilic Bacteria from Hot-Spring Environments in China (BL98031) ✍ BUSWELL John Anthony ● WILLIAMS R.A.D.*
1999-00	The Role of Chloromethane in the Fungal Degradation of Chloro- and Nitroaromatic Environmental Pollutants (BL99022) ✍ BUSWELL John Anthony
1997-98	The Development of Chinese Medicines and Dietary Supplements for Treating Gastrointestinal Disorders and Coughing (MD97131) ✍ BUT Pui Hay Paul ● FUNG Kwok Pui (Biochemistry) ● CHAN Tak Wah Dominic (Dept of Chemistry) ● HO Yee Ping (School of Pharmacy) ● WOO Jean (Dept of Medicine & Therapeutics) ● CHOW Hee Lum Albert (School of Pharmacy) ● LI Chi Keung Ronald (School of

Pharmacy)# ● ZHU Min (School of Pharmacy)# ● KWAN Yiu Wa (Dept of Pharmacology) ● LIN Ge (Dept of Pharmacology) ● CHAN Hsiao Chang (Dept of Physiology) ● KO Wing Hung (Dept of Physiology)

1999-00 Novel Anti-herpes Agent from Natural Product (CU99171)
✍ BUT Pui Hay Paul ● XU Hongxi (Institute of Chinese Medicine)# ● OOI Vincent Eng Choon

1999-00 Correlation Between Antitumor Activities and Structural Characteristics of Mushroom Polysaccharides (CU99161)
✍ CHEUNG Chi Keung Peter ● OOI Vincent Eng Choon ● ZHANG Lina*

1999-00 The Antioxidative Activity of Some Edible Mushrooms (BL99023)
✍ CHEUNG Chi Keung Peter

1997-98 Molecular Studies on Shellfish Allergens: Cloning, Sequencing, Expression and Immunological Responses (CU97321)
✍ CHU Ka Hou ● LEUNG P.S.C.* ● KWAN Hoi Shan ● FUNG Ming Chiu

1998-99 Development of Molecular Markers for Genome Mapping in Penaeid Shrimp (CU98062)
✍ CHU Ka Hou ● KWAN Hoi Shan

1999-00 Assessment of Environmental Safety of Aquaculture Farms Using Biochemical Indicators of Distress (BL99002)
✍ CHU Ka Hou ● WOO Norman Ying Shiu ● WONG Chong Kim ● TAM Pui Fun#

1999-00 Evolutionary and Population Genetics of Mitten Crabs, *Eriocheir* spp. (CU99162)
✍ CHU Ka Hou ● CHAN Tin Yam* ● SHEN Qi*

1999-00 Development of a Bioassay System for the Action of Androgenic Hormone in the Mud Crab *Scylla* (BL99024)
✍ CHU Ka Hou

1999-00 Chemical Characterization and Toxicological Studies of Landfill Leachate (BL99025)
✍ CHU Lee Man

1999-00 Origin and Mechanisms of the Formation of the Common Character Impact Volatile and Semi-volatile Flavor Components in Salted-dried Fishes for Nutrition and Food Safety Improvement (CU99164)
✍ CHUNG Hau Yin

1999-00 Headspace Analysis of Fermented Soybean Curds (BL99026)
✍ CHUNG Hau Yin

1998-99 Genetic Immunization Against Toxoplasma gondii (CU98142)
✍ FUNG Ming Chiu ● LEUNG Kwok Nam (Biochemistry) ● CHEN Xiao Guang*

1998-99 The Role of Prostaglandin D Synthase and Prostaglandin D JCS Cell and Normal Bone Marrow Cell Differentiation (BL98003)
✍ FUNG Ming Chiu ● MAK Nai Ki*

1999-00 Molecular Analysis of Different Interferon Alpha Subtypes (BL99009)
✍ FUNG Ming Chiu

1999-00 Transciptional Regulation of Gonadotropin-I & II (GTH-I & II) β Genes in the Goldfish by Activin - Functional Analysis of Cis-acting Elements that Mediate Activin Stimulation of GTH-Iβ & Inhibition of GTH-IIβ Expression in the Goldfish, *Carassius auratus* (CU99176)
✍ GE Wei

1999-00 Growth Hormone Regulation of Oocyte Development and Maturation in the Zebrafish (BL99010)
✍ GE Wei

1997-98 Yeast Complementation Analyses of Signal Transduction Genes Isolated from Early Fruit Body Development of Shiitake Mushroom *Lentinula edodes* (CU97322)
✍ KWAN Hoi Shan

1998-99 Elucidation of Gene Expression Profiles during Fruit Body Development of Shiitake Mushroom Lentinula edodes using Expressed Sequence Tags and Serial Analysis of Gene Expression (CU98139)
✍ KWAN Hoi Shan

1999-00 Germplasm Bank, Chemical and Molecular Characterization of Chinese Medicinal Plants Commonly Used in Hong Kong (BL99004)

✍ KWAN Hoi Shan ● CHE Chun Tao (School of Chinese Medicine) ● WONG Yum Shing

1999-00 Analysis of Mitogen Activated Protein Kinase (MAPK) Cascades Isolated During Fruit Body Development of Shiitake Mushroom *Lentinula edodes* Using Yeast Two-hybrid System (BL99011)
✍ KWAN Hoi Shan

1998-99 Asparagine Synthetase Genes: Their Roles in Plant Growth and Development (CU98292)
✍ LAM Hon Ming

1998-99 Production of Vaccines against Lymphocytic Choriomeningitis Virus (LCMV) in Transgenic Plants (BL98025)
✍ LAM Hon Ming ● SUN Sai Ming Samuel ● FUNG Ming Chiu ● SARON Marie-Francoise*

1999-00 Molecular and Biochemical Characterization of a Salt-tolerant Soybean Variety (CU99180)
✍ LAM Hon Ming ● SHAO Gui Hua*

1999-00 Salt Stress-induced Senescence in Soybean (BL99012)
✍ LAM Hon Ming ● SHAO Gui Hua*

1997-98 Characterization and Expression of Ribosome Inactivating Proteins in Plants and Mushrooms (CU97325)
✍ OOI Vincent Eng Choon ● SUN Sai Ming Samuel ● NG Tzi Bun (Biochemistry)

1999-00 Development of Two Potent Novel Antiviral Drugs from Traditional Chinese Medicinies (BL99001)
✍ OOI Vincent Eng Choon ● BUT Pui Hay Paul ● XU Hongxi (Institute of Chinese Medicine)# ● CHAN Kay Sheung Paul (Dept of Microbiology)

1999-00 Expression of cDNA Encoding a Mannose-binding Lectin (NTL) from Narcissus tazetta in Transgenic Tobacco Plant (CU99182)
✍ OOI Vincent Eng Choon ● SUN Sai Ming Samuel

1999-00 Apoptosis-induced Cancer Regression by Certain Active Components from TCM and Natural Products – A Flow Cytometric Study (BL99013)
✍ OOI Vincent Eng Choon

1997-98 Genetic Engineering of Sweet Protein Mabinlin for Increased Stability (CU97327)
✍ SUN Sai Ming Samuel ● WONG Yum Shing

1998-99 Production of High Value Pharmaceutical Proteins in Transgenic Seeds (BL98035C)
✍ SUN Sai Ming Samuel ● FUNG Ming Chiu ● LAM Hon Ming ● CHEN Xiao Guang* ● HAN Wei*

1998-99 Engineering the Brazil Nut Met-rich Protein for Reduced Allergenic Activity (CU98351)
✍ SUN Sai Ming Samuel ● LAM Wai Kei Christopher (Dept of Chemical Pathology)

1997-98 An *in situ* study of the phytoplankton-zooplankton trophic transfer in the Zhujiang River estuary (CU97313)
✍ WONG Chong Kim

1999-00 Development of Methods for Conducting Sediment Toxicity Tests with Amphipods from Hong Kong Waters (BL99014)
✍ WONG Chong Kim

1999-00 Services on Water Quality Monitoring in Marine Parks & Marine Reserve (BL99027)
✍ WONG Chong Kim ● CHU Lee Man ● CHU Ka Hou ● WONG Po Keung

1997-98 Enhancement of Metal Bioremediation by Rhizospheric Plant and Microbial Components (BL97014)
✍ WONG Po Keung ● OW David*

1998-99 Toxicological Study of Polycyclic Aromatic Hydrocarbon (PAHs) in MARPOL Wastes (BL98020)
✍ WONG Po Keung

1998-99 Removal and Recovery of Metal Ions from Electroplating Effluent by A Combined Chemical-Biomagnetic System (CU98134)
✍ WONG Po Keung ● CHUA H.*

1999-00 Integrated Chemical-Biological Treatment of Dye-Containing Effluent of Textile and Dyeing Industry (CU99174)
✍ WONG Po Keung ● YU Chai Mei (Dept of Chemistry)

1999-00 Degradation of Pentachlorophenol by Photocatalytic Oxidaton (BL99015)
✍ WONG Po Keung

1995-96 A Study of the Nutritional Quality and Potential Food Use of Some Underutilized Legumes (BL95043)
✍ WONG Yum Shing

1999-00 Free Radical Scavenging Activities and Antioxidative Properties of Plant Flavonoids (BL99016)
✍ WONG Yum Shing

1997-98 Evaluation of Novel Microencapsulated Formulations for the Improved Survival and Development of Cultured Marine Fish Larvae (CU97302)
✍ WOO Norman Ying Shiu ● COLLINS Peter M.*

1998-99 Effect of Prolactin and Growth Hormone on Heat Shock Protein 70 Expression in the Sea Bream *Sparus sarba* (BL98023)
✍ WOO Norman Ying Shiu ● DEANE Eddie Edward

1998-99 Enhancing Immunological Competence of Silver Sea Bream (*Sparus sarba*) Through the Combined Application of Salinity Adaptation, Hormonal Factors and Specific Vaccines (CU98135)
✍ WOO Norman Ying Shiu

1999-00 Protective Effects of Heat Shock Protein 70 (HSP70) against Environmental and Pathogenic Stress in the Marine Teleost *Sparus sarba* (CU99168)
✍ WOO Norman Ying Shiu

1999-00 Strategies for the Improvement of Marine Fish and Shrimp Culture: A Molecular Biological Approach (BL99005)
✍ WOO Norman Ying Shiu ● CHU Ka Hou ● WONG Chong Kim ● GE Wei ● CHAN King Ming (Biochemistry) ● CHENG Hon Ki Christopher (Biochemistry) ● HO Walter K. K. (Biochemistry)

RESEARCH OUTPUTS AND PUBLICATIONS

<P989281> **LAI K. M.; CHENG Man Yuen and WONG Po Keung.** "Integration of Biosorption and Biological/Photochemical Degradation of Synthetic Dyes in Industrial Effluent". *CRES-UNIDO (ICS) Workshop on Waste Management and Remediation of Polluted Sites for Sustainable Development* pp.51-81. Hanoi, Vietnam: Center for Natural Resources and Environmental Studies, Vietnam, 1998.

<P994695> **YUNG Y.K.; YAU K.; WONG C.K.; CHAN K.K.; YEUNG I.; KUEH C.S.W. and BROOM M.J.** "Some Observations on the Changes of Physico-Chemical and Biological Factors in Victoria Harbour and Vicinity, Hong Kong, 1988-1996". *Marine Pollution Bulletin* vol.39 no.1-12, pp.315-325. UK, 1999.

<P996784> **CHIU Chi Ming Lawrence and WAN M. F. Jennifer.** "Apoptosis Induced by Arachidonic and Eicosapentaenoic Acids in HL-60 Cells is Not Associated with Endonuclease Activation". Paper presented in the 8th International Symposium of Society of Chinese Bioscientists In America, organized by Society of Chinese Bioscientists In America 1999.08.14.

<P997942> **CHIU Chi Ming Lawrence and WAN M.F. Jennifer.** "Induction of Apoptosis in HL-60 Cells by Eicosapentaenoic Acid (EPA) is Associated with Downregulation of Bcl-2 Expression". *Cancer Letters* vol.145, pp.17-27. Ireland: Elsevier Science Ireland Ltd., 1999.05.31.

<P998036> **CHIU Siu Wai.** "Nutritional Value of Ganoderma Extract and Assessment of Its Genotoxicity and Antimutagenicity Using Comet Assays of Mouse Lymphocytes". *Food and Chemical Toxicology* vol.38, pp.173-178. 2000.

<P998364> **CHIU Chi Ming Lawrence; OOI Vincent Eng Choon and POON Suek Ching.** "Antiproliferative and Cytotoxic Effects of a Ribosome-Inactivating Protein from Agrostemma Githago on Human Leukemic Cells". *Bio/Pharma Quarterly* vol.5 no.4, p.34. Taiwan, 1999.12.

<P000340> **But, P.P.H.** "Safety Issues with Traditional Chinese Medicines". *Abstracts of the 7th World Conference on Clinical Pharmacology and Therapeutics* p.18. Florence, Italy: Block Well Science Ltd, 2000.07.15.

<P001082> **Cheung, P.C.K.; Wong K.H. and Masuyama R.** "*In vitro* Mineral Binding Capacity of Mushroom Fiber Prepared by Different Processes". *Abstracts of the 33rd Annual AIFST Convection* p.59. Brisbane, Australia, 2000.08.

<P001550> **Deane, Eddie E. and Norman Y.S. Woo.** "Exogenous Hormone Administration and its Effect on HSP70 Expression in Silver Sea Bream". *4th International Symposium on Fish Endocrinology* p.96. Seattle, USA: University of Washington, 2000.07.31.

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<P001893> **Woo, Norman Y.S.; Jun Li and Eddie E. Deane.** "Changes in Hormonal Status of Silver Sea Bream During Uibriosis". *4th International Symposium on Fish Endocrinology* p.48. Seattle, USA: University & Washington, 2000.07.31.

<P002095> **Chu, K.H.; H.Y. Ho and T.Y. Chan.** "Molecular Phylogenetics of the Mitten Crab (*Eriocheir s.l.)* Species (Crustacea: Brachyura: Graphsidae)". *Abstracts of the 18th International Congress of Zoological* p.29. Athens, Greece: Hellenic Zoological Society, 2000.08.

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<P002351> **LEUNG Patrick S.C. and CHU Ka Hou.** "cDNA Cloning and Molecular Identification of the Major Oyster Allergen from the Pacific Oyster *Crassostrea Gigas". International Marine Biotechnology Conference 2000, Program and Abstracts* p.99. Townsville, Australi: IMBC, 2000.09.29.

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<P007171> **CHIU Chi Ming Lawrence; OOI Vincent Eng Choon; CHEUNG Chi Keung Peter; DING Q. and ZHANG L.** "Antiproliferative and Apoptotic Effects of Poria Cocos Polysaccharides on Human Leukemic Cells". Paper presented in the Asian Mycological Congress 2000, organized by Centre For Research In Fungal Diversity, Dept. Of Ecology and Biodiversity, University of Hong Kong 2000.07.09.

<P007290> **CHIU Siu Wai.** "Programmed Cell Death is not Involved in Initiation of the Gill Cavity of Coprinus Cinereus: A Study Using Morphological Mutants". *Science and Cultivation of Edible Fungi* pp.115-120. Rotterdam: A. Balkema, 2000.

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<P008341> **WONG Po Keung; CHUA Hong; Wang L.; LO W.H.; YU P.H.F. and ZHAO Y.G.** "An Optimal Magnetite Immobilized Pseudomonas Putida 5-X cell System for Cu2+ Removal from Industrial Waste Effluent". *Water Sciecne and Technology* Volume 41 No. 12, pp.241-246. UK: IWA Publishing, 2000.

<P008628> **CHIU Chi Ming Lawrence; WAN M.F. Jennifer and OOI Vincent Eng Choon.** "Induction of Apoptosis by Dietary Polyunsaturated Fatty Acids in Human Leukemic Cells is Not Associated with DNA Fragmentation". *International Journal Of Oncology* vol.17, pp.789-796. Athens, Greece, 2000.07.26.

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<P010107> **GU Pei-Li; CHU Ka Hou and CHAN Siu-Ming.** "Bacterial Expression of the Shrimp Molt-Inhibiting Hormone (MIH): Antibody Production, Immunocytochemical Study and Biological Assay". *Cell Tissue Res* vol.303, pp.129-136. Berlin, Germany, 2001.

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<P010145> **TSOI K.H. and CHU K.H.** "Sexual Dimorphism and Allometric Growth of the Amphipod *Hyale Crassicornis* (Crustacea, Gammaridea, Hyalidae)". *Abstracts of the Postgraduate Conference on Marine Biology and Biotechnology* p.77. Hong Kong: The Chinese University of Hong Kong, 2001.06.

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<P010967> **童金苟、朱嘉濠、吳清江.** <魚類和水生動物基因組作圖研究的現狀及前景> 《水產學報》 第 25 卷 第 3 期, 頁 270-278. 中國上海, 2001.06.

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<P018620> **WONG Po Keung and WANG Jian.** "The Accumulation of Polycyclic Aromatic Hydrocarbons in Lubricationg Oil over Time - A Comparison of Supercritical Fluid and Liquid-liquid Extraction Methods". *Environmental Pollution* vol.112, pp.407-415. New York, USA: Elsevier Science Ltd., 2001.

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see also <P000151>, <P000713>, <P002100>, <P002166>, <P002169>, <P002170>, <P002210>, <P002540>, <P003169>, <P003424>, <P003684>, <P004159>, <P007169>, <P010410>, <P010499>, <P010501>, <P010574>, <P011267>, <P011671>, <P016626>, <P017600>, <P019449>

RESEARCH PROJECTS

Transition Metal-catalyzed Phosphinylation by Catalytic Phorsphorus-carbon Bond Activation

- ✍ CHAN Kin Shing
- ❑ 1 November 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

Phosphines are important chemical compounds for agricultural uses and as ligands for organometallic catalysis as well as important intermediates. The preparation of phosphines usually requires highly air-sensitive reagents. Functional group tolerance is therefore limited. A mild and neutral method for converting aryl and alkyl halides and their triflates into phosphines will be developed using transition metal complexes. This method aims to be economical and functional group tolerant.
(PS00806)

High-resolution Spectroscopy of CH_2^+ and NH_2^+: The Study of Rovibronic Interactions of Quasilinear Molecules

- ✍ CHAN Man Chor
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

This project investigates the electronic spectra of CH_2^+ and NH_2^+ in the near infrared region using high resolution laser spectroscopy. In addition to being important species in Astrophysics and Chemistry, both species exhibit interesting quantum mechanical properties that have been subjects for theoretical calculations. As quasilinear molecules with very low potential barrier at linear configuration, both CH_2^+ and NH_2^+ exhibit strong rovibronic interactions known as Renner effect. The researchers plan to study the details of this effect using rotationally resolved electronic spectroscopy. Due to their high reactivity and low abundance in molecular systems, the spectroscopic studies of these ions present a special challenge. The information obtained from this work will serve as a rigorous test for high level *ab initio* calculations which predict the rovibronic spectra. As the researchers' experiments mark the first high-resolution spectroscopic work on molecular ions in gaseous plasma pursued in Hong Kong, it is hoped that this work will introduce a new research discipline in experimental Chemical Physics to the local science community.
(CU00272)

Dissociation of Large Ions in a Fourier-transform Ion-Cyclotron-Resonance Mass Spectrometer

- ✍ CHAN Tak Wah Dominic
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

In this project, the researchers aim to develop a new scheme to activate mass-selected large-ions by using high-energy (keV) atom beam. In conversion CID experiments, ions of interest are first mass-selected and are accelerated to certain kinetic energies before colliding with an inert buffer gas. The center-of-mass (COM) collision energy is typically in a few eV for large precursor ions (m/z>1000 Da). By using a fast-atom (FA) gun, isolated ions of interest are subjected to bombardment by keV fast-atoms. By selecting different projectile atoms (e.g. argon-40 or xenon-131) and/or different kinetic energies, the target ions can be activated with high efficiency. Since the interaction time between the fast-atom and the target ion is in the order of 10 s and is independent of the mass of the target ion, high-energy electronic excitation of the target ions is likely to occur. In case of peptide/protein analysis, electronic excitation would lead to both sequence specific and side-chain specific product ions. The latter is particularly important for differentiating isomeric amino acids such as leucine and isoleucine.
(CU00274)

Artificial Globular Proteins: Synthesis and Characterization of alpha-Amino Acid-based Peptide Dendrimers

- ✍ CHOW Hak Fun
- ❑ 11 August 2000
- ❖ Research Grants Council (Earmarked Grants)

Polymers comprise a major portion of our world. It is also one of the fruitful areas where chemistry finds its application in daily life. One recent development in polymer chemistry has been the synthesis of highly branched, globular polymeric macromolecules known as dendrimers. In contrast to conventional polymer molecules, dendrimers are molecules of well-defined size, shape and topology. Dendrimers with a wide variety of structural diversities have been prepared and some of them possess, for examples, catalytic, liquid crystalline, photo-responsive, magnetic and plastic properties. However, most dendrimers reported so far are constructed by simple organic materials and only a few of them are constructed from naturally occurring biomolecules such as sugars and amino acids, and hence their full potential in biochemical and biomedical applications has not been thoroughly exploited. The use of bio-materials for dendrimer synthesis is an interesting concept and should lead to new, artificial products having similar structural and biological properties to those of their natural counterparts. In this project the researchers propose to synthesize a novel series of dendritic

biopolymers using naturally occurring α -amino acids. These highly branched, artificial biopolymers, having discrete molecular weights and globular topology, are reminiscent to proteins which are essential to our daily function. They can be used to model the function and properties of protein molecules such as their aggregation behavior in solutions. Realisation of such biological-based polymers thus provides us with a new insight of the function and properties of protein molecules.
(CU00273)

Development of Analysis Techniques for Deposits and Baths for the Electroplating Industry

- ✍ KWOK Wai Man Raymund ● HARK Sui Kong (Dept of Physics)
- ❑ 1 August 2000
- ❖ Shipley Asia Limited ● University-Industry Collaboration Programme: Teaching Company Scheme, ITF, Innovation & Technology Commission

Electroplating is a critical element in electronic packaging and metal industries. The new developments and the improvements of the electroplating processes require sophisticated characterizations in order to understand the plating processes and to test the properties of the deposits. The upgrade of the electroplating industry also requires qualified persons that can cope with the advanced characterization techniques and the technological know-how in the plating processes.
This project will train two Master of Philosophy students for the development of characterization techniques in electroplating. One of the students will concentrate on the reliability and failure analysis of the lead-free deposits for electronic packaging. The other student will develop a general method for the analysis of organic species in the electroplating bath. Both students will use the processing instruments in Shipley and the characterization instruments in The Chinese University of Hong Kong and Shipley.
(PS20005)

A Novel Technique for the Analyses of Depth Distribuitons of Chemical States and Compositions in Semiconductor Materials with Sub-nanometer Resolution

- ✍ KWOK Wai Man Raymund
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

It is very important to determine the chemical compositions, chemical states and structures of semiconductor and related materials for the process control, failure analysis and process optimization in the wafer fabrication industry and for the research and development of new materials in the academics, for example, the gatedielectric/Si structure, the layer structures in semiconductor laser devices, and the multilayer hard-coatings. This study will utilize commercially available surface analysis instruments and a low energy ion beam research instrument to develop a new analysis technique that can be routinely used for the industrial applications and academic research, and to study the fundamental issues of low energy Ar^+ sputtering of semiconductor and related materials.
In this study, the researchers' goal is to use Ar^+ beam of very low energy to reduce the depth of the ion-mixing region and use large electron take-off angle in x-ray photoelectron spectroscopy (XPS) to obtain the information of the undamaged layer. The obtained information will then reflect the actual surface chemical states and compositions. With a suitable algorithm, the researchers can remove the effect due to analysis depth of the instrument and achieve a depth resolution as low as the ion-mixing region. The technique will allow the accurate determination of the chemical compositions and chemical states of dielectric materials, semiconductors, metals and a combination of the three, and the determination of ultrathin dielectric layers/semiconductor structures with a depth resolution of better than 5Å.
(CU00230)

Solution Structure Studies of Nuclear Localization Signals in Viral and Disease Proteins

- ✍ LAM Sik Lok
- ❑ 1 December 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

In recent years, considerable efforts have been made to enhance the understanding of the nucleocytoplasmic transport mechanisms of karyophilic proteins. Selective and active transport of karyophilic proteins from the cytoplasm to the nucleus is crucial to the cell function and this process is mediated by a "signal" contained within karyophilic proteins. This "signal" is usually rich in basic amino acids and the signal sequence is often referred as nuclear localization signal (NLS). In this research plan, the researcher propose to investigate the solution behavior and structural features of NLSs in Influenza virus M1 matrix protein and Huntington's disease IT15 protein so as to provide insights into the principles and mechanisms of the nuclear import process. These viral and disease NLSs present an attractive new target for developing drugs to interrupt the process of viral replication or disease expression during nuclear import. In this investigation, solution structures of Influenza virus M1 matrix protein and Huntington's disease IT15 protein NLSs will be determined using circular dichroism (CD) and nuclear magnetic resonance

(NMR) spectroscopy. The solution structure information will help establish the relationships among NLS structures, nuclear import pathways and biological functions.
(PS00431)

Metal Complexes of a Tridentate Diamide Ligand

- ✍ LEUNG Wing Por Kevin
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

This project is to develop the synthesis of a series of novel metal diamide complexes and study their structures and reactivities. The ligand transfer reagent will be prepared by treatment of the dilithium dialkyl complex [{$(CHSiMe_3)_2C_5H_3N$-2,6}{$Li(TMEDA)\}_2$] derived from 2,6-lutidine with organonitriles RCN to give the 2,6-pyridyl-bridged bis-azaallyl dilithium complex [Li_2{$N(SiMe_3)C(R)CH\}_2C_5H_3N$-2,6]]. Metal bis-azaallyl complexes will be synthesized by the reaction of the dilithium bis-azaallyl complex with metal halides. It is anticipated that the extra coordination from the bridged-pyridyl nitrogen will change the structural features in this class of compounds. The ligand studying provides more flexibility in forming a six-member heterocyclic ring by virtue of the twisting of the metallacyclic ring; metal complexes formed will be less strained when compared with some related diamide ligands. The structures of these compounds will be studied by spectroscopic methods (NMR, mass spectroscopy) and X-ray structure determination.
(CU00265)

"Gaussian-3 Study on the Structures, Reactions, and Energetics of Some Interesting Chemical Systems"

- ✍ LI Wai Kee
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Accurate calculation of molecular energies is one of the major tasks of quantum chemistry. At present, quantum mechanical methods for the calculation of thermocehemical data have developed beyond the reproduction of experimental results; they are now able to make reliable predictions where experimental data appear to be uncertain or do not exist at all.
In the present project, the researchers propose to apply the recently published model of theory, Gaussian-3 (G3), designed by J.A. Pople (co-winner of the Nobel Prize in Chemistry, 1998) and his co-workers, to a variety of chemical systems. These applications may be broadly divided into the following categories:

(1) Analysis of experimental data from photoionization mass spectrometric studies;
(2) Structural and energetics studies of isomers and/or investigation of potential energy surfaces;
(3) Mechanistic studies of simple gas-phase reactions; and
(4) Assessment and possible modifications of the G3 method.

Besides yielding useful chemical results, these applications will also serve as additional tests for this newly developed method.
(CU00275)

Theoretical Study on Solvation Dynamics and Intracluster Reactions for $Al^+(H_2O)n$ Ion Clusters

- ✍ LIU Zhifeng ● TSE John S.*
- ❑ 15 September 2000
- ❖ Research Grants Council (Earmarked Grants)

The researchers propose a theoretical study on the ionic cluster $Al^+(H_2O)_n$, with n=1-20. Experimentally these clusters showed remarkable size effect in intracluster hydrogen elimination reaction, which is typical among metal ion/solvent clusters and is of fundamental importance to the understanding of chemical reactions in solution. The dynamical nature of this process, the size of the system, and the intracluster reactions make these ions difficult for conventional *ab initio* Hartree-Fock and molecular dynamics methods. The researchers plan to study these clusters systematically by *ab initio* molecular dynamics (AIMD) method, which combines the strengths of density functional theory and molecular dynamics methods and has shown its power in the study of metal and semiconductor clusters. The study consists of two parts. First for small clusters, $Al^+(H_2O)_n$ with n=1-6, detailed studies are performed to determine the best parameters for AIMD simulations, including the types of exchange-correlation functional, pseudopotentials, size of the periodic cell, and the length of simulation. In the second part, AIMD studies on larger clusters with n=7-20 will be attempted to locate the most stable structure and its isomers, to simulate the dynamics at finite temperature, and to elucidate the transformation between these isomers. From these simulation the researchers hope to gain insights into the solvation dynamics around Al^+, its dependence on cluster size, and the mechanism of intracluster reaction.
(CU00276)

Studies on the Coordination Chemistry of Acetylenediide and Pseudohalide Anions

- ✍ MAK Thomas Chung Wai
- ❑ 1 August 2000
- ❖ Research Grants Council (Earmarked Grants)

This proposal is concerned with fundamental research on the design, synthesis and structural characterization of two classes of inorganic compounds: (1) metal acetylides that contain the acetylenediide dianion; and (2) metal pseudohalides that possess one-, two-, or three-dimensional coordination networks.
The acetylide dianion (IUPAC name acetylenediide), C_2^{2-}, is iso-electronic with well-known ligands such as N_2, CN, CO and NO^+, but only scant information is available on its coordination properties. The pseudohalides are polyatomic, mesomerically stabilized monoanions that exhibit remarkable chemical similarity to the halide ions. The most important pseudohalide ions are: azide (N_3), cyanide (CN), cyanate (NCO), fulminate (CNO), thiocyanate (NCS), selenocyanate (NCSe), dicyanamide ($N(CN)_2$) and tricyanomethanide ($C(CN)_3$). They all exhibit a pronounced tendency to act as bridges between metal centers, thus generating numerous bi-and multi-nuclear complexes and coordination polymers.
A detailed study of the coordination modes of the acetylenediide and psudohalide anions will lead to a better understanding of the factors required for the crystal engineering of novel inorganic solids with potentially useful properties for scientific and industrial applications.
(CU00268)

Sandwich-like Metal Bis (tetrapyrroles)

- ✍ NG Kee Pui Dennis
- ❑ 1 September 2000
- ❖ Germany/Hong Kong Joint Research Scheme

Sandwich-type phthalocyaninato and porphyrinato metal complexes, in which the highly delocalised macrocycles are in close proximity, have been the subject of intensive research in recent years. Due to the strong electronic interactions between the π electron systems of the macrocycles, these complexes display unusual electrical, magnetic, optical and electrochromic properties. The double-decker complexes $M^{IV}(Por)_2$ (M = Ce, U, Th, Zr, Hf; Por = general porphyrinate) have also been proposed as models to mimic the structure and spectroscopic properties of the "Special Pair" found in the reaction centre of photosynthetic bacteria. This project involves the preparation of new homoleptic and heteroleptic double-decker complexes of tetrapyrrole derivatives such as phthalocyanines and porphyrins, and studies of their various physico-chemical properties.
(PS20001)

Bioconjugation of Phthalocyanines with Amino Acids and Peptides, Synthesis and Photophysical Properties in Micellar Systems

- ✍ NG Kee Pui Dennis
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Photodynamic therapy (PDT), first developed for cancer treatment, is branching out to many other clinical applications such as the treatment of macular degeneration of eyes, hardening of arteries, sun-induced precancerous skin lesions, and wound infections. The treatment involves the use of light-sensitive materials, which can selectively accumulate in certain cells and when excited by light of the correct wavelength and power, unleash reactive species such as singlet oxygen and hydroxyl radicals which are destructive to cells. Although the key issue of drug localization has not been resolved, it appears that the photosensitizers should have an affinity for low-density lipoproteins. Several amino acids and peptides have also been found to be able to enhance tumor cell targeting. The researchers therefore plan to link up these biological moieties to phthalocyanines which, owing to their unique and intriguing photophysical properties, are one of the promising classes of second generation photosensitizers. This family of bioconjugated macrocycles is virtually unknown so far. The proposed work involves the preparation and characterization of differently substituted zinc(II) and palladium(II) phthalocyanines conjugated with amino acids and small peptides. The photophysical properties of the resulting conjugates will then be studied in micellar systems which can well mimic the membrane functions.
(PS00397)

Synthetic Studies Toward Taxol: Contruction of an Optically Active ABC Ring from (+)-Carvone

- ✍ SHING Kung Ming Tony
- ❑ 1 November 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

Modem natural product synthesis has placed an added requirement for the organic chemists, i.e. the target molecules should be harvested in optically active form due to the different pharmacological response of the enantiomers. Taxol and the related taxotere are established anticancer drugs, particularly toward ovarian and breast cancers. Taxol is extracted from a plant, but the poor yield of its isolation procedure and limited availability renders the drug costly. Existing chemical syntheses (preparation) of taxol involve many steps and hence industrial scale production is not economical or practical. This research programme, at an initial stage, proposes to study the chemical preparation of the ABC ring of taxol via a shorter synthetic route. A successful outcome will allow further elaboration of the ABC

ring into taxol itself. These endeavor may facilitate the discovery of a commercially viable preparation of taxol.
(PS00598)

The Construction of Chiral 3-Dimensional Molecular Scaffolds Using Tetraphenylenols as Building Blocks

- ✍ WONG Nai Ching Henry ● MAK Thomas Chung Wai
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Molecular architecture has lately become an active research area. In the present project, the Principle Investigator (PI) will attempt to synthesize three tetraphenylenols in both their racemic and optically pure forms, as well as two other tetraphenylenols that are incapable of exhibiting optical activity. These compounds will then be inter-linked through the formation of metal phenoxides employing quadrivalent metal ions as the central linkage. The PI also hopes to control the "growth" of the metal ion molecular frameworks by manipulating the base ancillaries. The structures of these scaffolds will be determined by NMR spectral analysis as well as by X-ray crystallography. Development of these chiral molecular scaffolds into asymmetric catalysts, functionalized oligomers, nano-scale devices and molecular machines will be explored in the future.
(CU00264)

Synthesis of Compounds by Solution Phase Chemistry

- ✍ WONG Nai Ching Henry
- ❑ 1 April 2001
- ❖ Chiron Corporation

The project will be concerned with organic synthesis of lead compounds supplied by Chiron Corporation. The methods of synthesis will involve solution phas technique, as well as compound characterization. The structures of the compounds are however confidential.
(PS20007)

Phase Transitions of Novel Polymer Brushes

- ✍ WU Chi
- ❑ 31 December 2000
- ❖ Research Grants Council (Earmarked Grants)

A polymer brush can be prepared by grafting linear macromolecules onto a substrate, i.e., each chain has only one end attached onto the substrate. Polymer brushes can modify the surface of a given material and lead to many physicochemical applications, such as colloid stabilization, adhesion, chromatography, biocompatibility and wetting. A number of theoretical models have been developed to describe the grafted chain density profile under various conditions, but only a few experimental results have been reported because it is difficult, if not impossible, to make dense polymer brushes. It is generally known that the grafted chains are extended in a good solvent, but collapsed when the solvent quality becomes poor. In this study, the researchers propose to graft linear chains onto a thermally sensitive microgel surface so that the grafting density can be continuously increased via the shrinking of the microgel at higher temperatures. They intend to verify a long predicted grafting density induced phase transition on surface. On the other hand, by grafting thermally sensitive polymer chains onto a hydrophilic microgel surface, the researchers hope to differentiate various existing polymer brush models and have a better understanding of the phase behavior of the grafted chains. One of the envisioned applications of this study will be the preparation of polymeric nanoparticles with an "intelligent" surface.
(CU00266)

Imido-lanthanide Complexes: Synthesis, Structure, and Reactivity

- ✍ XIE Zuowei
- ❑ 1 July 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

Imido-transition-metal complexes play an important role both in biological processes such as nitrogen fixation and in a series of industrial processes. Cycloadditions, C-H bond activations, and ring-opening polymerizations can all be catalyzed by various imido-transition-metal complexes. Numerous imido-d-block-metal complexes have been reported; however, imido-lanthanide complexes have thus far remained elusive. The reasons for that are probably due to:
(1) the large size of the lanthanide ions,
(2) the lack of very bulky amine or aniline derivatives,
(3) the lack of proper method, and
(4) non-bonding f-orbitals.
The researchers propose here to explore the chemistry of imido-lanthanide complexes on the basis of their previous work in the field of organolanthanide chemistry. Several new very bulky amine and aniline as well as cyclopentadienyl derivatives or analogues will be designed and prepared, which will serve as σ and π ligands, respectively. It is hoped that the extremely bulky ligands could prevent the formation of any μ-imido complexes; as a result, complexes containing M=N

double bonds would be stabilized. The catalytic activities of these proposed complexes will be examined. It is anticipated that imido-lanthanide complexes should be more active than imido-d-block-transition-metal ones in the above-mentioned catalytic reactions.
(PS20002)

"Group 4 Metal Carborane Complexes: Synthesis, Structure, and Reactivity"

- ✍ XIE Zuowei
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

Polymers are an important class of materials and are possibly the most significant man-made chemicals with many diverse applications. They, with different microstructures and characteristics, can be custom-made just by varying the ligands on the catalysts. From this point of view, new ligands and then new catalysts are the resources of new polymers. In this proposal, the researchers plan to design new carborane-based novel "constrained geometry" ligands and mixed π ligands, to introduce them to group 4 chemistry, and then to study the catalytic activity of the resulting group 4 metal complexes in olefin transformations. It is anticipated that these group 4 metallocenes with new metal/charge combinations would be the precatalysts for the polymerization/copolymerization of olefins and polar monomers, which would result in new polymeric materials. These systems also provide an opportunity to probe the influence of metal charge on reactivity, which will offer some insight into the structure/reactivity relationships. The chemistry of this class of group 4 metal carborane complexes is expected to be significant and varied.
(CU00267)

Applications and Mechanisms of Photochemical Oxidation of Persistent Organic Pollutants

- ✍ YU Chai Mei ● ZHAO Jincai*
- ❑ 1 December 2000
- ❖ NSFC/RGC Joint Research Scheme

Environmental pollution has become a very serious problem in Hong Kong and the Mainland. Among the many pollutants that pose immense health hazards, synthetic dyes, chlorinated compounds, estrogen mimicking contaminants and non-biodegradable polymers are notorious for their persistence in the environment. As these toxic substances cannot be degraded efficiently by conventional bioremediation, more effective treatment methods must be developed. Photochemical oxidation is an emerging technique that is being actively pursued by research teams all over the world.

In the past three years, the two teams involved in this project have made important breakthroughs in photocatalytic oxidation and photo-Fenton's reactions. This track record lays a strong foundation for this project which will effectively utilize the experience of both teams: the Hong Kong team in the synthesis of novel photocatalysts and their characterization by state-of-the-art instrumentation; and the Mainland team in the mechanistic studies of photo-oxidation and the fabrication of photoreactors. This partnership is a perfect match for developing advanced photochemical oxidation treatment systems for the degradation of persistent pollutants. These systems should be able to effectively degrade persistent organic pollutants into environmentally acceptable products such as carbon dioxide and water. The reaction pathways will be studied in detail, and a pilot scale treatment facility will be set up.
(CU00033N)

Coating of Titanium Dioxide on Solid Substrates by Sol-Gel Method

- ✍ YU Chai Mei
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Photocatalytic pollution treatment has attracted a great deal of attention. However, the conventional powder catalysts often require a tedious post-treatment separation process. Coating the catalysts on a solid surface should overcome this major limitation. This project utilities the sol-gel processing method to apply a durable titanium dioxide thin layer on solids. Different substrates, including soda-lime glass, ceramic tile, metal and plastic will be tested. Optimum conditions for sol-gel processing, effects of doping on surface microstructure, hydrophilic property, antibacterial functions and transmittance of the thin films will be investigated. These thin TiO_2 photocatalytic films have tremendous potential in wastewater treatment and air purification. Results generated from this work may someday lead to the development of practical photocatalytic pollution remediation systems.
(PS00408)

Technical Evaluation on Ambient Air Treatment by Titanium Dioxide Based Photocatalyst in Hong Kong

- ✍ YU Chai Mei ● YU Jiaguo
- ❑ 7 May 2001
- ❖ Environmental Protection Department, HKSAR Government

When a photocatalyst is illuminated by sunlight or near UV, it generates a very powerful oxidizing agent. This oxidizing agent can oxidize common air pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs), and convert them to environmentally acceptable products. It is now technically feasible to coat a transparent thin film of TiO_2-based photocatalyst on glass, tiles and other materials. A building that purifies air automatically can be constructed, and it may be an attractive alternative to conventional anti-pollution measures. However, extensive laboratory tests are necessary before the photocatalytic building materials are applied in a large scale. The purpose of this project is to evaluate the applicability of TiO_2 based photocatalytic oxidation technique for ambient air pollution treatment in Hong Kong. A set of testing protocols suitable for the local environment will be developed, and commercial TiO_2 based photocatalytic products will be tested. Photo-reactors similar to that described in the researchers' publications will be constructed. The concentrations of NOx, CO, acetone, H_2O and CO_2 will be monitored in real-time under carefully controlled temperature and humidity conditions. Preliminary outdoor testing of photocatalytic products will be carried out on a rooftop platform at the CUHK Science Centre. Actual field tests will be conducted at an EPD roadside station. Photocatalytic sheets and blocks will be placed under direct sunlight, and the NOx concentrations in the vicinity will be recorded. The efficacy of this treatment method will be evaluated based on scientific and economic considerations.
(PS20008)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition — Title/Investigators

1998-99 Thermodynamic Studies of Sequence Specific Local Structure of DNA by UV Spectroscopy (PS98017)
✍ AU-YEUNG Chik Fun Steve

1999-00 Effects of Tandem Base Pair Mismatches on Local DNA Dynamics (PS99004)
✍ AU-YEUNG Chik Fun Steve

1994-95 Asymmetric Catalysis by Metal Complexes of Chiral Pyridyl Phenols and Their Derivatives (PS94010)
✍ CHAN Kin Shing

1998-99 Biological Evaluation Agreement: Obtaining Compounds to Evaluate for Agriculture Utility (PS98016)
✍ CHAN Kin Shing

1998-99 Asymmetric Catalytic Carbon-Carbon Forming Reactions Via Chiral Biaryls (CU98023)
✍ CHAN Kin Shing

1999-00 Activation of Carbon-Carbon Bonds by Transition Metal Complexes (CU99202)
✍ CHAN Kin Shing

1999-00 Synthesis of 1, 10-Phenanthrolines (PS99005)
✍ CHAN Kin Shing

1999-00 Forbidden Transitions of H_2 Studied by Cavity Ring Down Spectroscopy (PS99010)
✍ CHAN Man Chor

1999-00 Structural and Dynamic Studies of van der Waals Molecules Using High Resolution Spectroscopy (PS99017)
✍ CHAN Man Chor

1998-99 Mass Spectrometry of Carbohydrates (CU98345)
✍ CHAN Tak Wah Dominic

1998-99 Synthesis of [n]Paracyclophane-based Oligo[p-phenylene-(E)-vinylene]s with Configurational Chirality Residing in the Backbones (CU98121)
✍ CHAN Tze Lock

1998-99 Molecular Metamorphosis: A New Approach to the Synthesis and Dendritic Macromolecules via Post-Dendrimerization Modifications (PS98005)
✍ CHOW Hak Fun

1999-00 Synthesis and Characterization of Dendritic Networks (CU99201)
✍ CHOW Hak Fun

1998-99 Preparation of Nanocrystals-Doped SiO_2 Thin Films by RF-Sputtering Method (PS98002)
✍ HUI Ka Chung

1997-98 Interaction of Low Energy Ions and III-V Semiconductors (CU97705)
✍ KWOK Wai Man Raymund ● BELLO Igor* ● LAU Leo Woon Ming (Dept of Physics)

1998-99 Functionalization of Backbone Carbon on Polymer Surfaces with -COOH (CU98106)

✍ KWOK Wai Man Raymund ● LAU Leo Woon Ming (Dept of Physics) ● WU Chi ● CHAN Chi Ming*

1999-00 Materials Characterization and Failure Analysis for Electrodeposition (PS99027)
✍ KWOK Wai Man Raymund

1999-00 Piezoelectric Sensors for Chiral Biomolecules (PS99011)
✍ LAU Oi Wah

1998-99 Transition Metal Thiolate and Selenolate Complexes with Unusual Coordination Geometry as Mimics to the Active Sites of Metalloproteins (PS98018)
✍ LEE Hung Kay

1999-00 Zinc Complexes with Sterically Demanding Chalcogenato Ligands (PS99021)
✍ LEE Hung Kay

1990-91 Synthesis of Novel Transition-Metal Alkyls (BP90039)
✍ LEUNG Wing Por Kevin

1990-91 Synthesis of Organometallic Compounds of Alkali Metals (BP90040)
✍ LEUNG Wing Por Kevin

1998-99 Syntheses, Structures and Reactivities of Metal Aza-allyl Complexes (CU98126)
✍ LEUNG Wing Por Kevin

1997-98 First Principle Molecular Dynamics Study on the Reaction Mechanisms of Thermal Dissociation for Molecules and Energetic Materials (CU97711)
✍ LIU Zhifeng ● TSE John S.*

1998-99 A First Principle Study on the Bimolecular Reaction F2+C2H4 (CU98122)
✍ LIU Zhifeng ● TSE John S.*

1989-90 X-Ray Analysis of Crystal Structures (BP72001)
✍ MAK Thomas Chung Wai

1989-90 Metal Coordination by Betaines (BP88025)
✍ MAK Thomas Chung Wai

1997-98 Synthesis and Structural Studies of New Betaine Ligands and Their Metal Complexes (CU97702)
✍ MAK Thomas Chung Wai

1998-99 Synthetic and Structural Studies on Homo- and Heterometallic Complexes (CU98022)
✍ MAK Thomas Chung Wai ● TANG Wen Xia*

1999-00 Studies in Supramolecular Chemistry (CU99206)
✍ MAK Thomas Chung Wai

1998-99 Studies of Hydrophilic and Non-aggregated 2, 3-Naphthalocyanines and Phthalocyanines (CU98117)
✍ NG Kee Pui Dennis

1998-99 Sandwich-Like Metal Bis(tetrapyrroles) (PS98025)
✍ NG Kee Pui Dennis ● Johann W. BUCHLER*

1999-00 Development of Porphyrin-based Nonlinear Optical Materials (PS99012)
✍ NG Kee Pui Dennis

1999-00 Preparation of Phthalocyanine Derivatives for Optoelectronic Applications (PS99018)
✍ NG Kee Pui Dennis

1999-00 Development of Phthalocyanine-based Dyes for Optical Storage Media (PS99019)
✍ NG Kee Pui Dennis

1997-98 Enantiospecific Total Syntheses of Anticancer Agents Simalikalactone D and Quassimarin (CU97708)
✍ SHING Kung Ming Tony

1999-00 Enantiospecific Synthesis of Taxol Analogues as Potential Anticancer Agents (PS99006)
✍ SHING Kung Ming Tony

1989-90 Theoretical Studies of (a) Aluminium-Ethylene Complexes (b) CH_3SOH^+ (c) Ge Compounds (d) HPOH and HNOH (BP89048)
✍ SO Suk Ping

1989-90 Synthesis of Novel Aromatic Compounds (BP83001)
✍ WONG Nai Ching Henry

1997-98 The Use of Chiral Furanboronates in Organic Synthesis (CU97701)
✍ WONG Nai Ching Henry

1998-99 Synthesis and Reactions of 5,6-Bis (trimethylsily) benzo [c] furan (CU98014)

✍ WONG Nai Ching Henry

1999-00 Asymmetric Reduction and Alkylation of Chiral Furanoboronates (PS99022)
✍ WONG Nai Ching Henry

1997-98 Novel Fast Response Polymers and their Biomedical Applications (BL97009)
✍ WU Chi ● LEUNG Ping Chung (Dept of Orthopaedics & Traumatology)

1998-99 The Formation and Stabilization of Surfactant-Free Polymer Nanoparticles (CU98123)
✍ WU Chi

1999-00 Tracer Diffusion in Confined Geometry (PS99001)
✍ WU Chi ● SCHMIDT, Manfred*

1999-00 Design, Synthesis and Assembly of "Intelligent" Macromolecules (CU99209)
✍ WU Chi ● PAN Cai Yuan* ● LEUNG May Lay Louis*

1997-98 Lanthanacarborane Complexes: Synthesis, Structure and Reactivity (CU97706)
✍ XIE Zuowei

1999-00 Organolanthanide Compounds with a New Class of Versatile Ligands (CU99210)
✍ XIE Zuowei

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RESEARCH PROJECTS

Applications of Supercritical Fluid Extraction Techniques in Chinese Medicines

- ✍ CHE Chun Tao ● LIU Wing Keung Ken (Dept of Anatomy)
- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

The supercritical fluid extraction (SFE) technology has many advantages over the conventional extraction approach using aqueous and/or organic solvents. Among others, SFE is an instrumental method that allows precise control of all experimental conditions and provides electronic documentation of data. In the field of Chinese medicine research, an important task is to establish standards for quality assessment of herbal drugs and formulated products. While the conventional solvent extraction procedure is extremely difficult, if not impossible, to standardize, SFE can easily provide standardized and automatic procedures for quality assessment purpose. The researchers propose to study the feasibility of applying this extraction technique in the preparation of standardized extracts from Chinese medicines. For this application, they will shall focus on Gastrodia elata (天麻) and Schisandra chinensis (五味子) and their products. The chemical contents as well as the biological activities of extracts prepared by different methods (e.g. percolation, reflux, Soxhlet extraction) will be compared with those obtained by SFE. Results of this study will find applications in improving the quality and safety of herbal products. (BL00903)

Extraction Technology and Pharmacological Properties of Chai-Ge-Jie-Ji Preparation

- ✍ LIANG Songming ● CHE Chun Tao ● RONG Xiang Tao*
- ❑ 2 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

The Chai-Ge-Jie-Ji decoction is a traditional medicinal formula used for the treatment of common cold and influenza. The researchers have observed significant clinical effect of this prescription in patients. The long-term goal of this project is to develop a modern formulation based on the traditional prescription, using modern extraction, purification, and manufacturing technologies. The present project therefore sets the groundwork for basic science research, including aspects of manufacturing technology, standardization and quality assessment, as well as pharmacological and toxicological evaluations. During the first year of the project, the researchers will focus on the extraction techniques (to effectively extract the active ingredients by new approaches such as super-critical fluid extraction) and the pharmacological profile of the preparation (such as anti-viral, anti-bacterial, anti-pyretic, anti-inflammatory, analgesic sedative, and immunomodulating properties). (BL00841)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1999-00	Cytotoxic and Potential Anti-Tumour Compounds from the Chinese Drug "Lang-Du" and Their Mechanisms of Action (CU99169) ✍ CHE Chun Tao ● KONG Yun Cheung ● LIU Wing Keung Ken (Dept of Anatomy)
1999-00	Standardization of Chinese Medicines Using An Analytical Data Management System (BL99020) ✍ CHE Chun Tao
1997-98	Development of Over-the-Counter Pharmaceutical Products Based on Local Medicinal Plants (BL97039) ✍ KONG Yun Cheung ● KWAN Hoi Shan (Dept of Biology)

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RESEARCH PROJECTS

Topics in Curvature Flows

- ✍ CHOU Kai Seng
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Curvature is a geometric quantity mathematicians use to measure the derivation from flatness of a geometric object like a curve, a surface or a manifold. It plays a decisive role in many natural processes including motion of interfaces separating phases, propagation of activity waves in excitable media, and evolution of patterns in chemistry and biology. Dynamics describing them can be formulated as parabolic systems of nonlinear geometric equations, or curvature driven flows. The study of these flows has become a very active area in recent years. In this project the structure of some interesting curvature driven flows will be studied. Mathematical issues such as solvability and regularity, formation of singularities, stability and asymptotic behavior of these flows will be examined. The study will enhance our understanding on these complex systems.
(CU00294)

Integral Self-affine Tiles

- ✍ LAU Ka Sing
- ❑ 15 August 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

The art of tiling was developed in architectural designs since human history. It involves arranging congruent geometric objects (tiles) to fill up the plane or space with repeated patterns that has no overlap and no gap. Despite this simple idea, it appears to be a difficult subject and a systematic study of tiles in mathematics was started only very recently. It was partly motivated by the development of the solid state sciences of crystals and quasicrystals and tomography. The advanced computer technology also helps popularize the subject by generating a lot of eye-catching graphic designs.
The theory of tiling makes use of geometry, algebra, combinatorics and Fourier transformation. The researchers' investigation will concentrate on using the iterated function system of integral self-affine maps to generate the tiles and study the various properties.
(PS20003)

Ruelle Operators and Dynamical Systems

- ✍ LAU Ka Sing ● FAN Ai Hua* ● LEUNG Chi Wai
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

The Ruelle operator (also called the transfer operator) was first introduced by Ruelle to study the Gibbs distribution in statistical mechanics in terms of the potential and the temperature ([B], [R]). From the mathematical point of view, the Ruelle operator is a positive operator on a continuous function space, and the Ruelle theorem is the extension of the well known Perron-Frobenius theorem on positive matrices. Furthermore the operator brings together the important concepts of the variational principle and the entropy. The theory is rich and its impact has been felt in many different areas. Nowadays the Ruelle operator has become a standard tool in dynamical systems, fractal geometry, wavelets, stochastic processes and in the study of chaos.
The research will concentrate on the connection of the operator with the conformal iterated function systems. The maximal eigenvalue, the second maximal eigenvalue (in absolute value) will be investigated. Some related random dynamical system will also be considered.
(CU00293)

Explicit Construction and Decoding Algorithms of Algebraic-geometric Codes

- ✍ LUK Hing Sun ● YAU Shing Toung Stephen*
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

A major development in the theory and practice of error-correcting codes for almost two decades is the introduction of algebraic geometric codes which are more efficient and offer greater flexibility in the choice of code parameters. In particular the discovery of a sequence of codes exceeding the Gilbert-Varshamov bound was a significant breakthrough. Hence it is of great importance to construct good algebraic geometric codes explicity for application and to derive efficient decoding algorithms with strong error-correcting capacities.
In this project, the researchers propose to investigate the explicit construction of algebraic geometric codes from various special classes of algebraic curves, by computing the corresponding parameters, generator and parity-check matrices. Specifically they will study the Garcia-Stichtenoth towers of Artin-Schreier extensions, which are used in the explicit construction of codes exceeding the Gilbert-Varshamov bound. Along with the search for good algebraic geometric codes, the researchers propose to examine how the main existing decoding algorithms apply to the examples constructed, by finding the exact numbers of correctable errors and the complexities. They will seek good modification and generalization of existing decoding algorithms.

Progress in these directions would contribute significantly to information technology.
(CU00295)

Partial Ordering and Convexity in Applied Functional Analysis and Applications

- ✍ NG Kung Fu
- ❑ 31 December 2000
- ❖ Research Grants Council (Earmarked Grants)

This project is concerned with the study of convexity and partial ordering in the frame-work of functional analysis with a view of applications especially in the area of vector optimization and error bound analysis.
(CU00290)

On Hoffman's Error Bound and Vector Optimization

- ✍ NG Kung Fu ● HAN Zhiqing* ● WEN Song* ● HUANG L R*
- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

By virtue of functional analysis techniques especially involving generalized derivatives/sub-differentials and consideration of cones the researchers propose to study error bounds for system of functions.
(PS00674)

On Von Neumann Regularity of Infinite Matrix Subrings

- ✍ SHUM Kar Ping ● GUO Yuqi* ● NGUEYH Van Sanh* ● SEN M K* ● STRUKOV Segy P.*
- ❑ 30 September 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

The researchers investigate the regularity of infinite matrix subrings by using replacement techniques, established by K.P. Shum, of free modules. They have proved that if a ring R is regular if and only if the infinite matrix subrings $FM_\Gamma(R)$ which consists of Γ x Γ -matrices with only finitely many non-zero entries is still regular. In this project, the researchers aim to find a large class of infinite matrix subring $M_\Gamma(R)$ which are not regular if R is regular but not semi-simple. The relationship between the regularity and semi-simplicity of infinite matrix subrings will be investigated. They also want to generalize the results of R.F. Shanny in 1972.
(PS00587)

Analysis on Complete Manifolds

- ✍ WAN Yau Heng Tom ● LI Wai Kwong Peter*
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

In this project, the investigators propose to study the theory of harmonic functions and harmonic mappings of a complete manifold in relation to its geometrical structure. Firstly, they propose to understand the space of polynomial growth harmonic functions on a general class of manifolds that includes manifolds with non-negative Ricci curvature and also minimal submanifolds of Euclidean space which has Euclidean volumegrowth. This is also related to the conjecture of Yau on the first eigenvalue of an embedded minimal hypersurface in n-sphere. Secondly, they propose to understand two conjectures of Schoen. These are related to the understanding of the structure of the image set of harmonic maps and its implications to the underlining geometrical, topological, and complex analytical structures; and the understanding of the Dirichlet boundary value problem at infinity of quasiconformal harmonic diffeomorphisms between hyperbolic spaces. Finally, they propose to study the prescribed Hopf differential problem for harmonic maps from Riemann surfaces into symmetric spaces.
(CU00291)

Analysis of Some Problems for Incompressible Euler and Navier-Stokes Equations

- ✍ XIN Zhouping
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

The incompressible Euler and Navier-Stokes equations govern flows whose macroscopic speeds are much lower than the sound speed, such as water in the oceans and air in the atmosphere. The analysis of such nonlinear partial differential equations is important not only in the mathematical theory itself, but also in various applications to many fields such as aeronautics, meteorology, geophysics, oceanography, and turbulence theory, etc. Despite the tremendous progress achieved in the past, yet many basic issues concerning the analysis of the incompressible Euler and Navier-Stokes systems, such as time-evolution of 2-dimensional vortex sheets, robust numerical methods for 2-dimensional ideal singular flows, well-posedness theory for 3-dimensional Navier-Stokes equations, and stability (or instability) of boundary layers, etc., remain open and continue to challenge the field. The main goal of this research project is to continue our current effort to attack some of these problems by rigorous analysis, numerical calculations, and asymptotic methods. Specific problems to be investigated in this projects include: existence of self-similar multi-branched vertex sheets, the long time dynamics and approximations of vortex sheets,

development of singularities for 3-dimensional Navier-Stokes system, and boundary layer theory.
(CU00279)

A Finite Element Method for Nonlinear Convection Problems in Rapidly Rotating Spherical Shells with Applications to Planetary Fluid Systems

- ✍ ZOU Jun ● ZHANG Keke*
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Convective fluid motions strongly affected by rotation in rapidly rotating spherical fluid shells are encountered in many geophysical and planetary physical problems. Because of spherical geometry and rotational effects, a numerical approach has to be employed to study the convection problem.
Nearly all the major numerical models that are currently used for studying the problem of rotating spherical convection are based on the spectral-type method. There exists, however, well-known computational inefficiency for the Legendre transform and, furthermore, the global nature of the spectral method causes difficulties in an efficient implementation on massively parallel computers.
To study strongly nonlinear convection in rapidly rotating spherical systems that are relevant to planetary systems like the Earth's liquid core, it is needed to develop a new generation of the computational methods that take full advantage of modern massively parallel computers. The researchers propose to develop a new algorithm that is based on a finite element method which divides a spherical shell into tetrahedral elements together with domain decomposition methods.
The new algorithm is particularly suitable for an efficient implementation on parallel computers.
(CU00292)

Numerical Methods for Solving the Singular Maxwell Equations

- ✍ ZOU Jun ● Ciarlet Patrick* ● Garcia Emmanuelle*
- ❑ 1 June 2001
- ❖ France/Hong Kong Joint Research Scheme

In this proposal the researchers will investigate some efficient numerical methods for solving the three-dimensional Maxwell equations with singularities. The singularities may arise from the non-smoothness of the boundary of the physical domain. Such problems are widely encountered in the applications from engineering and industry, since in the physical domains there are often not smooth, for example, with corners and edges on their boundaries.
The researchers will extend the Singular Complement Method to deal with the singular Maxwell equations in three-dimensional non-convex domains. There remain basically two major difficulties: the first one is that the subspace, which complements to the subspace spanned by the computed solutions, is of infinite dimension, contrary to the two-dimensional case. The second one is that it is much more intricate than in two-dimensional cases to compute the test-functions, which are to be added to sufficiently enlarge the space of numerical solutions in the Singular Complement Method.
(PS20006)

Cohomology of Moduli Spaces of Vector Bundles and Fundamental Groups of Quasi-Compat Kahler Manifolds

- ✍ ZUO Kang ● SUN Xiaotao* ● YANG Yihu*
- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

To study Topology of Moudli spaces of Vector bundles over curves by degeneration method. To study fundamental groups of quasi-compact Kähler manifolds by using harmonic, Hermitian-Yang-Mills metrices and non-abelian Hodge-Theory.
(PS00538)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1999-00	Iterative Method for Ill-Conditioned Toeplitz Systems (CU99212) ✍ CHAN Hon Fu Raymond ● NG Kwok Po*
1999-00	Total Variation Image Restoration (PS99008) ✍ CHAN Hon Fu Raymond ● STROHMER Thomas* ● KILMER Misha* ● YU Wai Kuen*
1999-00	Lie Symmetry Related Properties of Some Curvature Flows (PS99009) ✍ CHOU Kai Seng ● QU Chang Zheng*
1998-99	Convolution Equations Associated with Scalings (CU98057) ✍ LAU Ka Sing ● LEUNG Chi Wai
1999-00	Multifractals, Iterated Function Systems and Stochastic Models (CU99215) ✍ LAU Ka Sing ● ANH Vo Van*

1998-99 Invariants of Compact Strongly Pseudoconvex CR Manifolds and Applications (CU98051)
✍ LUK Hing Sun ● YAU S. T. Stephen*

1998-99 Asymptotic Analysis of Optimization and Variational Problems (CU98002)
✍ NG Kung Fu ● PANG Jong Shi*

1999-00 Semigroups and Combinatorics Applications (CU99216)
✍ SHUM Kar Ping

1999-00 Harmonic Maps and Harmonic Functions on Noncompact Manifolds (CU99217)
✍ TAM Luen Fai

1997-98 Some Contributions to Linear & Nonlinear Analysis (PS97025)
✍ TAM Ping Kwan ● TAN Kok Keong*

1997-98 Harmonic Maps and Structures of Manifolds (CU97722)
✍ WAN Yau Heng Tom

1997-98 On the Effect of Domain Geometry and Topology in Nonlinear Elliptic Equations (CU97723)
✍ WEI Juncheng

1999-00 Point Condensations Generated by Reaction-Diffusion Systems (CU99218)
✍ WEI Juncheng

1999-00 Analysis of Nonlinear Evolution Partial Differential Equations in Compressible Fluids (CU99219)
✍ XIN Zhouping

1998-99 Efficient Numerical Methods for Solving Inverse Problems (CU98004)
✍ ZOU Jun

1998-99 Numerical Methods for Ill-Posed Problems in Computed Tomography (PS98027)
✍ ZOU Jun ● Peter MAASS* ● Dicken VOLKER*

RESEARCH OUTPUTS AND PUBLICATIONS

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RESEARCH PROJECTS

Velocity and Temperature Statistics in Turbulent Convection

- ✍ CHING Shuk Chi Emily
- ❑ 1 November 2000
- ❖ Research Grants Council (Earmarked Grants)

Most fluid flows in natural environment, in engineering application, and in everyday life are turbulent. The motion of air in the earth's atmosphere and flows in water pipes are two common examples. Turbulence is a problem of practical importance. For example, atmospheric turbulence plays a fundamental role in the transfer of heat and moisture, which has a considerable effect on changes in weather, and also determines the spreading of pollutants. Turbulence is also one of the greatest challenges in physics for which a satisfactory theory is yet to be developed. A key issue in the fundamental studies of turbulence is to make sense of the apparently random fluctuations displayed the various physical quantities such as velocity and temperature. In this project, the researchers will study turbulent convection in which fluid motion is driven by an applied temperature difference. Thermal convection is a good model system for studying turbulence and also poses interesting questions of its own. The researchers propose to carry out a systematic study of the statistical properties of both the velocity and temperature fluctuations, and their relation to each other using measurements available in recent experiments. They will particularly address the interesting issue of whether and how the characteristics of turbulence are affected by buoyancy.
(CU00286)

Cosmic Ray Telescope

- ✍ CHU Ming Chung ● LEE Yuk Yan ● CHENG Kai Ming ● TONG Shiu Sing Dominic ● WONG Wing Hung ● LAU Leo Woon Ming ● Chan Ki Hung*
- ❑ 1 August 2000
- ❖ Quality Education Fund, HKSAR Government

The researchers' goal is to set up a network of cosmic ray detectors distributed over ten secondary schools and involve both the students and teachers in a forefront collaborative scientific research project. Modeling after the ALTA project in Canada, this project presents a unique opportunity for secondary school students to actively participate in the process of modern collaborative scientific research as well as a large range of related skills and knowledge, including astrophysics, particle physics, particle detection, data analysis, and electronics. Simply put, the proposed project aims at giving our students early exposure to research and thereby incubating the spirit of scientific discovery in them.
(PS20004)

Energy Focusing of Waves in a Cavity with Oscillating Boundaries

- ✍ CHU Ming Chung
- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Since Moore's pioneering work in 1970, there have been intensive studies of the wave solutions in a cavity with moving boundaries. The topic is of fundamental theoretical interest in that it reveals a number of delicate features of quantum physics such as the dynamical modification of the Casimir force and the vacuum emission of photons with nonclassical photon statistics. On the other hand, the subject is also of practical importance since it bears implications on high-precision optical interferometry, the manipulation of quantum states, the generation of squeezed light, and quantum nondemolition measurements, etc.
One of the most interesting phenomena associated with the wave solutions in a one-dimensional oscillating cavity is the concentration of the wave amplitudes and the energy into narrow wave packets when the cavity vibrates at resonance frequencies. The amplitudes of these energy wave packets grow rapidly in time, producing sharp and intense pulses of photons. The researchers propose to extend previous calculations to two and three-dimensional (circular and spherical) cavities, so that the properties of electromagnetic waves as well as matter waves in these cavities can be studied. Based on their experience in the one-dimensional case, the researchers expect large nontrivial modifications of the fields at resonance, and they propose to study the consequences of these on physical processes, such as photon emission and Casimir effects. Studying the matter waves in a "dynamical bag" model will shed new light on the phenomenology of strongly interacting particles.
(PS00566)

Mechanical Behavior of Bulk Nanostructured Alloys Synthesized by Rapid Solidification

- ✍ KUI Hin Wing
- ❑ 1 November 2000
- ❖ Research Grants Council (Earmarked Grants)

In engineering new materials for structural applications, researchers have commonly used the Hall-Petch relationship, which links an increase in mechanical strength to a decrease in grain-size, to

urge for grain refinement. While materials with grain-size down to a few nanometers have indeed been prepared and many of them have outstanding mechanical properties, ironically the Hall-Petch relationship has been found inappropriate in this grain-size regime. The issue is rather intricate because accurate determination of grain-size dependence of mechanical properties has been hindered by:

(1) nanostructured materials prepared to date often have many voids which critically degrade mechanical strength;
(2) these materials also commonly possess a rather wide distribution in grain-size, which makes the determination of size-dependence difficult; and
(3) the current technology in the fabrication of these materials typically gives only "mini"-samples, such as disks of one cm in diameter and 0.1-0.2 cm in thickness, which is too small for conventional tensile strength measurements.

Recently, the researchers have successfully developed a novel technique for the growth of bulk nanostructured alloys which posses no void and a narrow grain-size distribution. In this study, they propose to fabricate samples of such nanostructured alloys with a physical dimension large enough for conventional tensile strength measurements, and use them as model samples to collect data on mechanical properties and their changes under stress, as a function of grain-size in the nanometer regime.
(CU00170)

Studies of Laser-induced Voltage in Rare Earth Doped Manganite Thin Films

- ✍ LEE Wing Kee ● ZHANG Peng Xiang*
- ❑ 1 February 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

In recent years, $Ln_{1-x}B_xMnO_3$(Ln=La, Pr, Nd,..., and B=Ca, Sr, Ba, Pb,...) thin films have received much attention due to the fact that they exhibit colossal magnetoresistance effect (CMR) and thus may have important applications in recording and sensor technologies. Laser-induced voltage (LIV) in $La_{1-x}Ca_xMnO_3$ thin films grown on different types of substrates will be investigated. Properties to be investigated include:

(1) Laser-induced voltage, electrical resistance (and its anisotropy) as functions wavelength, magnetic field, and temperature;
(2) Structure deduced by using X-ray diffraction and micro-Raman spectroscopy;
(3) Self-organization studied by using scanning tunneling microscopy and atomic force microscopy.

(PS00585)

Applications of Quasinormal-Mode Expansion in Open Wave Systems

- ✍ LEUNG Pui Tang
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

Physical phenomena occurring in open wave systems, from which energy and matter are lost continuously, are ubiquitous in nature. Optical emission from excited atoms in an imperfect optical cavity (e.g., a laser resonator) and radiation of gravitational waves from relativistic stellar objects (such as black holes and neutron stars) are two widely studied examples of these phenomena. Although these two kinds of systems differ greatly in their physical dimensions and nature, both of them can be analyzed in terms of relevant quasinormal modes (QNM's), which are decaying eigenstates with complex eigenfrequencies. In fact, it is often expedient to use the quasinormal-mode expansion (QNME) to analyze the dynamics of open systems, in a way that parallels the normal mode expansion (NME) in closed systems. However, owing to the non-conservative nature of open systems, QNM's are not guaranteed to form a complete set and the development of QNME has been plagued by the lack of a generic theory of QNM's. Recently, the researchers have developed various methods of QNME and established the completeness relation of QNM's for broad classes of open wave systems. In this research project, they propose to analyze the generation and propagation of waves in several open systems, including dielectric microspheres, black holes and neutron stars, with the QNME. These systems and related wave phenomena are of physical importance in their own right and QNME serves as a powerful tool to study and characterize them. In addition, properties of QNM's, including the problem of completeness, perturbation scheme and asymptotic behaviors of QNM's, will also be investigated. By studying the properties of QNM's in various physical systems, the researchers aim at developing a more complete and systematic approach towards open wave systems.
(CU00282)

Phase Separation in Colossal Magnetoresistance Materials

- ✍ LIN Hai Qing ● CAMPBELL David Kelly*
- ❑ 1 September 2000
- ❖ Research Grants Council (Earmarked Grants)

The researchers propose to conduct a theoretical investigation of the phase separation phenomenon observed in colossal magnetoresistance materials. The physically relevant model to be used consists of Zener's double exchange model plus superexchange between localized managanite spins and Coulomb

interactions between electrons. They will employ a variety of numerical techniques (exact diagonalizations, quantum Monte Carlo simulations) and analytic methods (low density approximation, unrestricted Hartree-Fock, functional integral, 1/S expansion) to tackle the subtle many-body correlations that arise from the complex interplay of electron-electron and electron- spin interactions, and obtain the phase diagram of these materials as a function of chemical substitution. Effects of Jahn-Teller distortion will also be discussed. The researchers' studies will reveal the physical nature of phase separation in colossal magnetoresistance materials and shed light on the understanding of other magnetic systems.
(CU00288)

New Developments in High Temperature Superconductivity Theory

- ✍ LIN Hai Qing ● YU Kin Wah ● LAU Leo Woon Ming ● HU Bambi* ● NG Tai Kai* ● LEUNG Pak Wo*
- ❑ 1 June 2001
- ❖ The Croucher Advanced Study Institute

To clarify the current status in high temperature superconductivity (high T_c) and to define its future development. To identify recent crucial experiments and their implications on possible theories. To survey recent novel theories in high T_c and their experimental tests.
(PS20009)

Advanced Dye-doped Sol-gel Silica Lasers

- ✍ LO Yam Kuen Dennis
- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Advanced dye-doped sol-gel laser system meeting the needs of medicine and spectroscopy will be designed, built and characterized spectroscopically and temporally. The researchers propose to build a flashlamp-pumped sol-gel dye laser that yield per pulse output of 0.1 -1 Joules. The pulse duration is a few microsecond, allowing many intra-cavity round trips to shape the beam. Such laser should find use in photo-dynamic therapy. Dye-doped sol-gel materials will also be used as the gain medium in the distributed feedback (DFB) arrangement that produces tunable output of narrow linewidth. The researchers have already had success with R6G dye-doped DFB lasers using the the crossing beam from a frequency-doubled Nd: Yag laser to create the gain modulation structure. In view of the ultra-short generation capability and the temperature variation of the output wavelength, their future work will focus on the time behavior and temperature tuning of the dye-doped sol-gel DFB lasers.
(PS00448)

Study of In-site Reactions During the Sintering Process of Aluminum-based Metal Matrix Composites

- ✍ NG Hang Leung Dickon
- ❑ 1 December 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

In the last decade, many techniques had been developed to produce various types of Al-based metal matrix composites (Al-MMCs). The method usually involves high temperature firing of mixture of Al and other ceramic powders. During the firing process, chemical reactions occur, and the microstructure and composition of the final products therefore usually bear no resemblance to those of the starting material. In order to produce high quality Al-MMCs and to optimize the fabrication procedures with minimal cost, it is essential to understand the mechanism in the formation of the various phases that act as the embedded reinforcements in the matrix of the composite. A new type of Al-MMC had been made by using the powder metallurgy method. The reinforcements were Al_2O_3 ceramic whiskers and Al-Mo intermetallic phases which were in-situ formed during sintering.
In this project, the researchers aim to: (1) study the in-situ reactions between the compacted powder mixture of Al and the oxide of Mo during the fabrication of the Al-based metal matrix composite (Al-MMC), (2) model the chemical reactions and the mechanism in the in-situ formation of the reinforcements in the Al-matrix, and (3) study the relationship between the microstructure of the Al-MMC and its physical, mechanical and thermal properties. They also aim to seek possible ways to optimize the process and properties of this composite.
(PS00664)

The Development of Polycrystalline Light-emitting Device in Ultra-violet Region

- ✍ ONG Hock Chun Daniel ● HO S T* ● CHAN Y C*
- ❑ 1 September 1999
- ❖ Research Grants Council (Earmarked Grants)

Light-emitting devices such as lasers have gained a wide spread of applications in communications, displays and compact-disc technologies. Electronic materials called semiconductors are the basic elements for assembling these devices. Structurally perfect semiconductors are essential to the device fabrications because the presence of small amount of

material imperfections or defects in semiconductors will degrade their light emission efficiencies and shorten the life-time of the devices. However, making structurally perfect semiconductors is a difficult and expensive task. Therefore, the current intentional research effort is being pursued to identify certain semiconductors which emit light effectively even consisting of a lot of defects. Nonetheless, the researchers have recently discovered that ZnO has a very high tolerance on defects. This has led them to realize the *first* laser action in *polycrystalline or defective* semiconductor in the world. Their results point to the potential of developing a new generation of polycrystalline optoelectronic devices once the material issues of ZnO are understood. In this project, the researchers will study the structural, optical and electrical properties of ZnO in great extent and attempt to unravel the light-emitting mechanism of this material. In addition, some simple but unique polycrystalline light-emitting devices such as light-emitting diodes and quantum wells will be explored. Their performance will be evaluated.
(EE99660)

The Study of ZnO for the Use of Polycrystalline Optoelectronic Devices

- ✍ ONG Hock Chun Daniel ● DU G T* ● HO S T* ● DAI J Y*
- ❑ 1 March 2000
- ❖ NSFC/RGC Joint Research Scheme

Acquiring the know-how on using polycrystalline compound semiconductors to fabricate light-emitting diodes (LEDs) and solid state lasers has always been the dream of scientists and engineers. The possible outcomes of using polycrystalline semiconductors can result in a cheaper way of making LEDs and lasers, in which their market is estimated to be more than 30 billion in US dollars each year for use in mobile phones, CD players, and other luminescent displays. However, our current stage of technology is still practicing single-crystal-like materials and the making of single crystals is difficult and expensive. Much of the expenses on the R&D of optoelectronics have been spent solely on making high quality semiconductors. Recently, the UV laser action in polycrystalline ZnO has been demonstrated by the research members and the results aim to the direction of producing polycrystalline solid-state devices once the material and device issues are resolved. The objective of this project is therefore to conduct a comprehensive investigation on the material and device aspects of ZnO. The Hong Kong research team will focus on the material preparation and science of ZnO and attempt to understand the underlying light emitting and charge transport mechanisms in the presence of extended and point defects. On the other hand, the Mainland team will concentrate on the fabrication of optoelectronic devices such as LEDs and UV detectors.
(EE99461)

Production a Web-based Self-Learning Package for Secondary School Teachers in Hong Kong: Using Contextual Themes in the Teaching of Physics in Secondary Schools

- ✍ TONG Shiu Sing Dominic ● WONG Wing Hung ● LAU Leo Woon Ming
- ❑ 15 January 2001
- ❖ Education Department, Hong Kong SAR Government

In 2003 a new physics syllabus at the secondary 4-5 level will be launched in Hong Kong. The new syllabus utilizes the contextual approach of teaching which aims to enhance students' motivation of learning by demonstrating the relevance of physical phenomena to daily life and the rapid advance of technology. The project will provide a self-learning package on the web to support teachers in acquiring this new teaching approach. The contents will:
(1) serve to arouse teachers' awareness and enrich their knowledge in this approach;
(2) provide teachers with updated and relevant information on contextual themes and activities;
(3) enhance teachers' competence and creativity in designing and conducting contextual activities and project work in secondary schools;
(4) develop teachers' proficiency in planning, implementing, monitoring and evaluating contextual activities and projects; and
(5) support and facilitate sharing of innovative ideas, experiences and resources.
(ED20020)

Development of a Technique for and the Determination of the Viscous Boundary Layers in Low Prandtl Number Turbulent Convection

- ✍ XIA Keqing
- ❑ 1 December 2000
- ❖ Research Grants Council (Earmarked Grants)

Turbulent convection has direct relevance to atmospheric and oceanic research for obvious reasons, and to engineering applications such as heat transfers in nuclear and chemical reactors. Despite many progresses made in this active area of research, we still do not have a fundamental understanding of this important natural phenomenon. This is especially true regarding to the mechanism of heat transfer at very high Rayleigh numbers, a regime directly linked to the above mentioned phenomena/applications. The most well-known model for turbulent convection is perhaps the Rayleigh-Benard (RB) system, a fluid layer confined between two horizontally parallel

conducting surfaces subject to a constant temperature difference. Here the researchers propose to develop a novel technique for the determination of the viscous boundary layer in RB turbulent convection. This new method will be suitable for viscous layer measurements in a wide range of fluids such as gases, liquid metals, and organic fluids, which are inaccessible to either laser or seeding particles that are essential in most optical techniques for velocity measurements. The researchers will then apply the new technique to measure viscous boundary layers in a RB convection cell using pressurized gas at very high Rayleigh numbers and low Prandtl numbers. The results will help us to resolve some currently controversial issues and answer some important questions in turbulent convection.
(CU00281)

First-Principles Approach to Dynamic ER Effects in Complex Fluids

- ✍ YU Kin Wah
- ❑ 1 August 2000
- ❖ Research Grants Council (Earmarked Grants)

The phenomenon of electrorheology (ER) did not enjoy rapid technological success in years following its development due to some poorly understood underlying mechanisms. In this proposal, first-principles methods are developed to investigate various ER effects, with the aim to clarify the underlying mechanisms. The methods will be extended to study the ER effects of coated particles, crystalline particles, and to magnetorheological effects of paramagnetic particles. Moreover, the nonlinear ER effects under a strong applied field will be studied. The approach is also applied to the evaluation of the hydrodynamic interactions between the unsteady fluid flow and the suspending particles. The results will give a better understanding towards the mechanisms necessary to design improved ER fluids and devices that enable the commercialization of ER technology.
(CU00284)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1998-99	Statistics and Scaling in Turbulence (CU98119) ✍ CHING Shuk Chi Emily
1997-98	General Relativistic Astrophysics: Coalescences of Neutron Star Binaries (CU97712) ✍ CHU Ming Chung ● LEUNG Pui Tang ● SUEN Wai Mo*
1998-99	Structure and Dynamics of Multi-Component Bose-Einstein Condensates (PS98008) ✍ CHU Ming Chung
1998-99	Pattern Recognition of Radar Echoes for Rainstorm Forecasting (PS98024) ✍ CHU Ming Chung ● WONG Wing Hung
1997-98	Vehicular Traffic Flow Problems: Statistical Physics Approaches (CU97714) ✍ HUI Pak Ming
1998-99	Theory of harmonic generations in random composites of nonlinear dielectrics (CU98129) ✍ HUI Pak Ming
1989-90	Microstructure of Undercooled Ge and Si (BP87003) ✍ KUI Hin Wing
1989-90	The Viscosity of Easy Glass Formers (BP87004) ✍ KUI Hin Wing
1998-99	Development of Advanced Surface Analysis and Engineering Technologies for the Metal Finishing and Related Industries (PS98023) ✍ LAU Leo Woon Ming ● KWOK Wai Man Raymund (Dept of Chemistry) ● WILSON Ian Howard (Dept of Electronic Engineering) ● YEUNG L. K. Kinny* ● LO W. Y.*
1998-99	Engineering New Etching Processes for Semiconductors with Hyperthermal Ion Bombardment (CU98315) ✍ LAU Leo Woon Ming
1998-99	Service Engineer for the Advanced Surface and Materials Analysis Centre (EE98047C) ✍ LAU Leo Woon Ming
1999-00	Materials Studies of Chemical Nickel Bumping for Enhancing the Reliability of Low-cost Flip-chip Technology (PS98029) ✍ LAU Leo Woon Ming
1999-00	Promotion of Creativity with a "Student-Centred" Approach in Teaching and Learning Experimental Science and Engineering (PS99028) ✍ LAU Leo Woon Ming ● WONG Hong Kuen ● KUI Hin Wing ●

WILSON Ian Howard (Dept of Electronic Engineering) ● CHU Ming Chung ● TONG Shiu Sing Dominic ● LEE Yuk Yan ● WONG Wing Hung ● MAK Se Yuen (Dept of Curriculum & Instruction) ● CHAN Jimmy S F* ● SHIN Franklin G*

1999-00 Engineering Homoepitaxial Growth Of cBN (CU99440)
✍ LAU Leo Woon Ming

1999-00 Frontiers in Surface Analysis and Their Novel Applications (PS99020)
✍ LAU Leo Woon Ming

1998-99 Decoherence Effects of Quantum Computers (PS98010)
✍ LEUNG Pui Tang

1998-99 Electron-Phonon Interactions in Highly Correlated, Quasi-One-Dimensional Electronic Materials (CU98120)
✍ LIN Hai Qing ● CAMPBELL David Kelly*

1999-00 Phase Segregation in Manganses (PS99013)
✍ LIN Hai Qing

1999-00 Valuation of European Options Subject to Default Risk Using Signaling Process (PS99023)
✍ LO Chi Fai ● HUI Cho Hoi*

1997-98 Experimental Study of Dye-Doped Sol-Gel Derived Silica as Tunable Solid State Laser Materials (CU97504)
✍ LO Yam Kuen Dennis

1998-99 Tunable solid state lasers in the VUV pumped by discharge excimer lamp (CU98024)
✍ LO Yam Kuen Dennis

1999-00 Dye-doped Sol-gel Materials for Low Power Optical Processing Applications (CU99366)
✍ LO Yam Kuen Dennis

1998-99 Processing and Properties of A1-Basesd Metal Matrix Composites Reinforced by Ceramic Particles and Intermetallic Compounds (PS98011)
✍ NG Hang Leung Dickon

1999-00 An IT-based Resource Package for Secondary Schools in Hong Kong (Subject: Physics) (ED99035)
✍ TONG Shiu Sing Dominic ● WONG Wing Hung ● CHU Ming Chung ● LAU Leo Woon Ming

1995-96 Interplay of Magnetic and Superconducting Properties of Oxide Multilayers (PS95016)
✍ WONG Hong Kuen

1997-98 Oxygen Effects in Colossal Magnetoresistance Materials (CU97718)
✍ WONG Hong Kuen

1999-00 Non-destructive Dating of Ancient Ceramics by Laser Induced Thermoluminescence (CU99009)
✍ WONG King Young ● LO Yam Kuen Dennis ● LEE Chung Kay ● LAU Leo Woon Ming ● KWOK Wai Man Raymund (Dept of Chemistry) ● NING Hung Pun Gary (Art Museum)

1993-94 Study of Statistical Nature of Particle Motion in Fluids (BP00101)
✍ XIA Keqing

1994-95 Experimental Studies of Turbulent Convection (PS94012)
✍ XIA Keqing

1999-00 Experimental Investigation of Turbulent Convection at High Rayleigh Numbers and in Large Aspect-Ratio Cells (CU99224)
✍ XIA Keqing

1998-99 The Inversion Problem for Quasinormal Modes (CU98006)
✍ YOUNG Kenneth ● LEUNG Pui Tang ● LING Siu Hing* ● SUEN Wai Mo* ● WONG Samuel S. M.*

1998-99 Optical Nonlinearity Enhancement via Electric Field Induced Aggregation (CU98290)
✍ YU Kin Wah

1999-00 Laterally Confined Surface Plasmons and Electron Image States in Corrugated Metal Surface (PS99014)
✍ YU Kin Wah

RESEARCH OUTPUTS AND PUBLICATIONS

<P994661> **LUI K.M.; BOLOTIN I.; KUTANA A.; BYKOV V.; LAU W.M. and RABALAIS J.W.** "How Do Hydrogen Atoms on Surfaces Affect the Trajectories of Heavier Scattered Atoms?". *Journal of Chemical Physics* vol.111 no.24, pp.11095-11100. 1999.12.22.

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RESEARCH PROJECTS

Statistical Inference for Long Memory Processes

- ✍ CHAN Ngai Hang
- ❑ 31 December 1998
- ❖ Research Grants Council (Earmarked Grants)

Long memory time series have been found to have important applications in various disciplines. Although significant progress has been made on discrete-time long memory series during the last decade, relatively little is known about its continuous-time counterpart. Owing to the advent of computing technology, data are observed more frequently and continuous-time models provide a natural platform to study phenomena where data are becoming increasingly available. This project focuses on two important aspects of long memory time series. Investigating the theoretical underpinnings such as the long-run behaviour of a continuous long memory time series constitutes the first part of this project. To study a general class of continuous time long memory models, issues involving fractional derivatives with respect to a Brownian motion have to be investigated. New probabilistic tools involving stochastic calculus of fractional Brownian motion will be developed. Once the long-run behaviour is established, the issue of selecting the right model within a given class arises. The second topic of this project concerns the model selection problem of continuous-time long memory models. In continuous-time series, since variability is measured in terms of the variability of the underlying Brownian motion which has an unbounded variation in any given finite time interval, traditional methods for discrete-time models break down. New probabilistic and statistical techniques must be developed. Completion of these two interrelated topics will bring important insights into the understandings of long memory models which will enhance considerably the applicability of long memory models to time series data in finance, business, and many other scientific disciplines.
(CU98082)

Long-memory Time Series Analysis of Disk Access Patterns

- ✍ CHAN Ngai Hang
- ❑ 15 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

This project studies the inference and applications of long-memory time series in high frequency data of computer disk design and finance. Its main objective is to build flexible long-memory time series models for input-output disk data where both long-memory and heavy-tailed phenomena are observed. This project will be conducted in collaboration with computer scientists from the parallel Data Lab (PDL) form Carnegie Mellon University. The joint collaboration provides a natural platform for data sharing and a conducive environment for scientific interactions. From the PDL, the researchers gain access to large amount of data from major vendors including Hewlett Packard which will be useful to build realistic statistical models for disk design.
(PS00494)

Testing Equivalence in Paired-sample Design: An Exact Unconditional Approach

- ✍ CHAN Ping Shing Ben ● CHAN Siu Fung Ivan* ● TANG Man Lai#
- ❑ 1 October 2000
- ❖ Research Grants Council (Earmarked Grants)

Equivalence studies are usually performed to determine if the sensitivity of a new diagnostic test is equivalent to (or no more than 100△ per cent less than) the sensitivity of a standard where△ (>0) is a pre-specified small quantity. An efficient and economic design is to conduct the comparison on the same individuals, whose outcomes are summarized in a matched 2x2 table. Similar situations also arise in new drug evaluations in cross-over clinical trials and matched-pair case-control studies where the endpoint of interest is dichotomous. Various equivalence tests based on large sample theory have been proposed. However, the validity of these tests are unknown in studies with small sample sizes. In this research, the researchers plan to (1) develop a general procedure for an exact tests for equivalence in matched 2x2 table; (2) develop an efficient method for sample size and power calculation, which is a critical component in designing experiments of this kind; and (3) develop an efficient procedure for constructing exact confidence intervals for the difference. These proposed exact procedures guarantee the validity of equivalence tests and are particularly desirable in small studies. The researchers will implement these procedures in non-commercial computer programs and make them available to practitioners.
(CU00261)

Wavelets in Statistical Function Estimation and Nonparametric Inferences

- ✍ FAN Jianqing
- ❑ 15 August 2000
- ❖ Research Grants Council (Earmarked Grants)

This project proposes two inter-related frontiers of research in data-analytic modeling for processing multi- dimensional data that arise from many

scientific disciplines. The first one is on wavelet applications to statistical function estimation. The innovation of the newly proposed techniques is that they are based on penalized likelihood approaches with non-concave penalty functions. Popular hard and soft thresholding approaches can be regarded as specific cases of the penalized likelihood methods when data are regularly sampled. The newly proposed methods are readily applicable to other nonparametric models, arising from engineering, finance, epidemiology, bio-medical applications. The second topic is on developing generally applicable inferential tools for a wide array of nonparametric models. A sieve-likelihood approach is proposed, which is an extension of traditional maximum likelihood ratio tests. The proposed ideas are widely applicable. They can be readily applied to various statistical models. They can be used to answer questions, *without imposing restrictive model assumptions*, such as if certain variables or factors are statistically significant for public health; if some risk factors contribute significantly to the survival time of patients; and if classical parametric models have excessive modeling biases, among others.
(CU00299)

Nonparametric Techniques in Financial Modeling

- ✍ FAN Jianqing
- ❑ 1 December 2000
- ❖ CUHK Research Committee Funding (Direct Grants)

This project intends to study a few inner related problems in financial modeling. Many financial models in use are simple and convenient parametric models. They are not derived from economic theory. Thus, it is possible that a wrong model could lead to erroneous pricing of contingency claims and hedging strategies. To address this issue, many nonparametric approaches have recently been introduced to estimate instantaneous returns and volatilities. Differencing techniques are frequently used. The researchers' first study is to examine the impact of higher order differencing. While they would clearly reduce discretization errors, the higher order differences have huge hidden cost: the variances of the estimators based on higher order differences escalate exponentially fast. Economic conditions change from time to time. Thus, it is reasonable to expect that the instantaneous return and volatility depend on both time and price level of a given state variable such as stock prices and bond yields. Time-dependent diffusion processes will be used to model the term structure dynamics and stock price volatilities. Semiparametric and nonparametric techniques will be introduced to estimate parameter functions in these models. With these flexible nonparametric techniques, the question arises whether a simpler model would fit adequately a given set of financial data. One may ask for example whether the geometric Brownian motion model fits the SP500 data, whether the Cox, Ingersoll and Ross model describes adquately the term-structure dynamics, and whether the short-term interest rate follows a time-homogeneous model, among others. Generalized likelihood ratio approaches will be introduced to testing these hypotheses.
(PS00997)

Linear Dynamic Models for Ranking Data

- ✍ GU Ming Gao
- ❑ 2 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Ranking data are very common in many fields of social and scientific investigation. Companies want to know consumers' order of preference; psychologists want to know the ranking of certain reactions under some stressful situations; social and political leaders want to know which factors are important in an election campaign; sports organizations want to rank their athletes according to the true abilities. Analysis of ranking data has developed over the years and many models and estimation methods are well established and documented. See, for example, the monograph edited by Critchlow and Fligner (1993) or Marden (1995). However, all those models are static in a sense that they assume the data are produced in one instant of time and change for the model over time is not allowed. In practice, such changes are inevitable. It is well known that consumers' order of preference changes over time, sometime due to effective marking campaign. It is also known that athletes' ability would change over time due to training or age. The researchers propose a dynamic state-space model to analyze ranking data. Unlike the traditional linear state-space model, in the proposed model, both state and "observed" variables are unobserved and only the rankings of the "observed" variables are actually observed. For the purposes of estimating the model parameters, the researchers' approach consists of simulating the latent variables with the Markov chain Monte-Carlo methods and employ the Kalman-filter methodology.
(PS00963)

Influence Diagnostics for Statistical Models with Missing Data and Their Applications to Models with Latent Variables

- ✍ LEE Sik Yum
- ❑ 1 October 2000
- ❖ Research Grants Council (Earmarked Grants)

On the basis of different emphases, natures of the applications and assumptions, recent advances of statistical and psychometric theory lead to the developments of many general models with latent random variables. These models have been extremely useful in behavioural, educational, medical and social sciences. On the other hand, as pointed out by Cook (1977, 1986), an important component of data analysis is to study how critical the statistical inferences are affected by the hypothesized model or unusual aspects of the data. The most common techniques for assessments of these concerns are the case-deletion measures and/or the local influence measures of minor perturbations of the model. However it is very difficult to apply Cook's approaches to complicated latent variable models. One objective of this project is to cooperate with the powerful EM algorithm in developing generalizations of Cook's approaches to assess local influence of model perturbation and derive case-deletion measures for general statistical models with missing data. Another objective is to investigate how to apply the new approaches to important latent variable models; and hence contribute new methodologies for analysis of these models. These methodologies will be applied to substantive real data sets in business, education and social science.
(CU00356)

A Graphical Approach for Determining the Order of Non-stationary Time Series

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- ❑ 1 January 2001
- ❖ CUHK Research Committee Funding (Direct Grants)

Most economic, scientific or engineering time series are non-stationary. To achieve stationarity, a frequently used technique is to differencing the series d times. Stationarity is the most important assumption to make statistical inferences in time series analysis. In time series, choosing a right order d for a given time series has long been recognized as an important problem and has become one of main streams for decades. The well-known Box-Jenkins (1970) method based on visual justification of whether slow or fast decay occurs in the plot of the autocorrelation function is welcome by pragmatists as an easy and intuitive graphical approach. However, many researchers reported the drawbacks due to the ambiguity between "fast" and "slow". The Famous Dickey-Fuller (1979) unit root test method based on rigorous statistical testing theory are welcome by statisticians. However, the testing formulae and their powers strongly depend on the distribution assumption of the series. Also, it seems that relying only a single statistic does not fully utilize the information carried by series. Following Cressie's work (1988), Chen and Anderson (1994, 1998, 1999) proposed the polyvariogram methodology. The property of polyvariogram is a promising feature for determining d. In this project, a graphical procedure based on the polyvariogram is introduced with no distribution assumption. Early simulation results have already shown that the new method is absolutely superior over Box-Jenkins' graphical method and has competing powers in hypothesis testing comparing to the unit-root method. However, further theoretical study and extensive simulation are required for developing a solid applicable methodology.
(PS00661)

Please refer to previous issues of this publication for more details of the following ongoing research at the department:

Edition	Title/Investigators
1999-00	Bayesian Computation in Software Reliability (EE99027) ✍ CHAN Ping Shing Ben ● CHAN Siu Fung Ivan*
1999-00	Multiple Comparison with a Control in Partially One-sided Families (PS99024) ✍ CHEUNG Siu Hung ● Dr KWONG Koon Shing*
1999-00	Markov Chain Monte Carlo and Stochastic Approximation Methods for Statistical Computing (CU99226) ✍ GU Ming Gao
1999-00	The Review of the Central Registry of Drug Abuse (PS99025) ✍ LAU Tai Shing ● Mr CHAN Char Nie*
1989-90	Analysis of Continuous and Polytomous Variables (CS85001) ✍ LEE Sik Yum ● POON Wai Yin
1989-90	Analysis of Incomplete Data (CS88002) ✍ LEE Sik Yum ● POON Wai Yin
1989-90	Analysis of Structural Equation Models with Correlated Data (CS89006) ✍ LEE Sik Yum ● POON Wai Yin
1999-00	Analysis of Structural Equation Models with Functional Data (PS99015) ✍ LEE Sik Yum
1999-00	Statistical Developments of Nonlinear Structural Equation Models (CU99088) ✍ LEE Sik Yum
1998-99	Optimal Sequential Sampling Plans (PS98015)

✍ LI Kim Hung

1989-90 Analysis of Fuzzy Data (CS89005)
✍ POON Wai Yin ● LEE Sik Yum ● LEUNG Y. P.*

1998-99 Further Developments on the Local Influence Approach (CU98186)
✍ POON Wai Yin ● POON Yat Sun* ● LEE Sik Yum

1999-00 Influence Analysis with Ordinal Categorical Variables (PS99016)
✍ POON Wai Yin

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<P002822> **LI Kim-Hung and CHAN Nai Ng.** "Degeneracy in Heteroscedastic Regression Models". *Journal of Multivariate Analysis* vol.74, pp.282-295. Brugge, Belgium, 2000.08.

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see also <P010555>