量子信息科技学术研讨会 **(2018.9.17-21)**

# 报告

## 金剛石量子傳感的研發及其在凝聚態物理和生物醫學方面的應用

## Developing Diamond Based Quantum Sensing for Applications in Condense Matter Physics and Biomedicine

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### 讲者介绍 Biography

Quan Li is Professor at The Chinese University of Hong Kong. She obtained her B.S. in Chemistry from Beijing University in 1997, and her PhD in Materials Science and Engineering from Northwestern University in 2001. She joined CUHK in 2002 as an Assistant Professor, and was promoted to Associate Professor and Professor in 2007, and 2011, respectively. Her research interests include functional materials and structures development, characterization and property measurement of individual nanostructures, and quantum sensing. Her work of quantum sensing is devoted to sensor development and applications in both condense matter physics and biomedicine.

### 报告摘要 Abstract

The optical properties of nitrogen vacancy (NV) centers in diamond are sensitive to its spin states, making NV centers effective quantum sensors for applications ranging from condense matter physics to biomedicine. The long spin coherence time of NV center electrons make it particularly attractive in biological applications. However, the sensitivity and working conditions of NV centers in diamond sample largely limits its practical applications. For example, NV center is sensitive to magnetic noises, but less sensitive to certain parameters such as temperature and pressure, and not at all response to many other important biochemical parameters such as pH and non-magnetic biomolecules. On the other hand, NV works well at low temperature/ambient conditions, but fails at elevated temperatures due to signal loss, making high temperature sensing applications impossible.

Our group aims at developing diamond NV based new sensing tools towards a broad range of applications. In the present work, I will discuss a few on-going directions towards this goal. I will first show possible schemes of constructing nanodiamond based hybrid sensors, which lead to significantly enhanced sensitivity and/or potentially enable the measurement of various biochemical parameters using NV based quantum sensing. The working mechanism of the sensor is based on coupling of nanodiamond (ND) and magnetic nanoparticles (MNP). We demonstrated in the present work feasible temperature sensors and show the proof-of-the-concept demonstration of temperature sensing using such hybrid sensors. The hybrid nano-thermometer under ambient conditions provides a new tool to study condensed matter physics, materials science, and biology at nanometer scale. In enabling the high temperature sensing using NV, we show that by room temperature initialization/readout and high temperature control, manipulation of quantum coherence of NV center electron spins can be achieved up to 1000K.

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