学术报告

题 目: Surface-enhanced Raman scattering spectroscopy for studying quantum plasmonics and monitoring chemical reaction dynamics

报告人: 雷党愿 讲师
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时 间: 12 月 12 日（周五）上午 10:00

地 点: 卢嘉锡楼报告厅（202）

欢迎参加!

固体表面物理化学国家重点实验室
化学化工学院
12 月 10 日

Title: Surface-enhanced Raman scattering spectroscopy for studying quantum plasmonics and monitoring chemical reaction dynamics

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时间：2014 年 12 月 12 日上午 10 点
地点：卢嘉锡楼报告厅（202）

Abstract: In the last decades, surface-enhanced Raman scattering (SERS) spectroscopy has become a versatile vibrational spectroscopic technique with a number of applications in the chemical, material and, in particular, life sciences. In the first part of this talk, I will show our recent work on the use of SERS spectroscopy for probing the spatial nonlocality effect – a quantum mechanical phenomenon, which is recently believed to set an ultimate limit of plasmonic near-field enhancement in metallic nanostructures with critical dimensions on the order of a few nanometers or less [1]. I will present our theoretical and experimental investigations on the effect of spatial nonlocality in metal films with controllable surface roughness [2]. Our results reveal that the spatial nonlocality effect on the metal dielectric response has to be taken into account for more accurate prediction of the SERS enhancement at large surface roughnesses. Current work focuses on the SERS spectroscopy of both spatial nonlocality and quantum tunneling effects in metal nanoparticle dimers with tunable interparticle distance down to subnanomemter scales [3]. In the second part, I will show the use of SERS spectroscopy for monitoring catalytic reaction dynamics provided that plasmonic metal nanoparticles for Raman enhancement are properly integrated with catalytic metals to form single entities [4]. I will present a facile approach for synthesizing Au@Pt core/shell nanostructures with controllable surface density of sub-5 nm Pt nanoparticles on the surface of Au nanorods. Systematic investigations on both SERS and catalytic activities of the hybrid nanostructures reveal an optimized surface coverage of Pt. More importantly, taking advantage of their dual functionalities, the hybrid nanostructures are able to track the Pt-catalyzed reaction in real time by measuring the SERS signals of the reactant, intermediate and final products. The same concept has been applied to other reactions such as plasmon-enhanced photocatalytic reactions by using hybrid metal-semiconductor photocatalysts [5]. Finally, I will introduce the design and fabrication of a novel three-dimensional hierarchical porous plasmonic metamaterial structure, its application in reproducible, ultrasensitive SERS spectroscopy and the physical understanding of the cascaded multiscale electromagnetic field enhancement in the structure [6].

References:

[1] C. Ciracì et al, *Science* **337**, 1072 (2012).
[2] Y. Zhao, X. Liu, D. Y. Lei & Y. Chai, *Nanoscale* **6**, 1311 (2014).
[3] X. Yu, D. Y. Lei et al, *Nano Today* **8**, 480 (2013).
[4] Z. Y. Bao, D. Y. Lei et al, *Nanoscale*, **6**, 9063 (2014).
[5] Z. Y. Bao, X. Liu, J. Dai, Y. Wu, Y. H. Tsang & D. Y. Lei, *Appl. Surf. Sci.* **301**, 351 (2014).
[6] X. Zhang, Y. Zheng et al, *Adv. Mater.* Accepted (2014).

Biography: Dangyuan Lei received his BSc and MPhil degrees, both in Physics, from Northwest University and The Chinese University of Hong Kong in 2005 and 2007, respectively. In October 2008, he went to Imperial College London to conduct his PhD studies, under the supervision of Prof Stefan Maier and in long-term collaboration with Prof Sir John Pendry, and obtained his PhD degree in Physics in 2011 with his thesis awarded the prestigious prize “Anne Thorne PhD Thesis Prize”. He is currently an assistant professor in the Department of Applied Physics at The Hong Kong Polytechnic University since September 2012. His main research activities include nanophotonics and nanomaterials studies, with particular interest in surface plasmon-enhanced light-matter interactions at the nanoscale and their applications in energy harvesting, optoelectronic devices and biochemical sensing. Since 2007, he has published 50 scientific publications on high-profile peer-reviewed journals such as Nature communications, Nano Today, Advanced Materials, Nano Letters, ACS Nano, Physical Review Letter, Laser & Photonics Review, and Energy & Environmental Science, with a total citation of 690 times.

简历：雷党愿博士于 2005 年在西北大学获得理学学士学位，随后于 2007 年在香港中文大学获得物理哲学硕士学位。雷博士于 2011 年在英国帝国理工学院取得物理哲学博士学位，师从世界著名纳米光子学专家 Stefan Maier 教授，并长期与世界著名超材料研究专家 Sir John Pendry 教授保持合作关系，博士论文曾获得帝国理工学院颇具声望的“Anne Thorne PhD Thesis Prize”。雷博士于 2012 年 9 月初受聘为香港理工大学应用物理学系助理教授，从事纳米光子学与纳米材料的相关研究，以及它们在纳米材料研究，光催化和光合成研究，以及光伏器件和生物传感器方面的应用。从 2007 年开始，雷博士先后在 Nature Communications, Nano Today, Advanced Materials, Nano Letters, ACS Nano, Physical Review Letters, Laser & Photonics Review 和 Energy & Environmental Science 等著名杂志发表学术论文 50 篇，这些文章先后被包括 Science, Nature Materials, Discovery Channel, Science Daily, PhysOrg.com and Nanotechweb.org 等杂志和媒体专门评述和作为“研究亮点”专门报道，总引用率达 690 多次。