TERS-6, The 6th International Conference on Tip-Enhanced Raman Spectroscopy
Aug. 16-18, 2017, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA.

INVITED

Tip-enhanced Raman Spectroscopy for Nanoscale Characterization of Surface Reaction and Dynamics

Bin Ren
State Key Laboratory of Physical Chemistry of Solid Surfaces, MOE Key Laboratory of Spectrochemical Analysis and Instrumentation, Collaborative Innovation Center of Chemistry of Energy Materials, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China
Email: bren@xmu.edu.cn

Collaborators: Shengchao Huang, Jinhui Zhong, Kaiqiang Lin, Tengxiang Huang, Haisheng Su, and Xiang Wang

Abstract

Tip-enhanced Raman spectroscopy (TERS) can not only obtain the topological but also vibrational information of a sample at the nanometer resolution. It is a very promising nanospectroscopy. In this talk, we used TERS to spatially resolve the site-specific electronic and catalytic properties of an atomically well-defined Pd/Au(111) bimetallic model catalyst at 3 nm resolution with molecular fingerprints. Benefiting from this high spatial resolution, we can directly visualize the distinct chemical (electronic) and physical (plasmonic) properties of the Pd island edges compared with the Pd terrace sites on a Au(111) surface. We also extended the study to Pt islands on Au(111) surface

Most of previous TERS studies were performed in air or UHV. If TERS study can be performed in the electrochemical environment, the electronic properties of the surface can be well controlled so that the interaction of the molecules with the substrate and the configuration of the molecules on the surface can be well controlled. We designed a special spectroelectro-chemical cell to eliminate largely the distortion of the liquid layer to the optical path and have been able to obtain TER spectra of reasonably good signal to noise ratio for surface adsorbed molecules under electrochemical potential control. Furthermore, we are able to synergistically control the reaction by both electrode potential and laser power, and characterize the reaction with nanometer spatial resolution. We further extended EC-TERS to 2D materials.

Reference:

[1] X. Wang, S. C. Huang, T. X. Huang, H. S. Su, J. H. Zhong, Z. C. Zeng, C. Zong, M. H. Li, and B. Ren, *Chem. Soc. Rev.*, **46**, 4020–4041(2017).
[2] J. H. Zhong, X. Jin, L. Meng, X. Wang, H. Su, Z. Yang, C. T. Williams, and B. Ren, *Nat. Nanotechnol.*, **12**, 132-136 (2017).
[3] X. Wang, J. H. Zhong, M. Zhang, Z. Liu, D. Y. Wu, and B. Ren, *Anal. Chem.*, **88,** 915-921(2016).
[4] Z. C. Zeng, S. C. Huang, D. Y. Wu, L. Y. Meng, M. H. Li, T. X. Huang, J. H. Zhong, X. Wang, Z. L. Yang, and B. Ren, *J. Am. Chem. Soc.*, **137**, 11928 (2015).
[5] Z. Liu, S. Y. Ding, Z. B. Chen, X. Wang, J. H. Tian, J. R. Anema, X. S. Zhou, D. Y. Wu, B. W. Mao, X. Xu, B.

Ren, and Z. Q. Tian, *Nat. Commun*., **2**, 305(2011).