Surface enhanced Raman scattering observation of molecular adsorption geometries on well-defined metal substrates

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ABSTRACT

Surface enhanced Raman scattering (SERS) is a powerful tool to obtain chemical information about metal/organic interfaces. Since signal enhancement in the SERS process is induced by excitation of surface plasmon polaritons, this spectroscopic method is normally applied to plasmonic metal substrates with nanoscale surface features. Thus, controlling the plasmonic property of these substrates, based on recent technological advancements in nanofabrication, is one of the main issues in the research field of SERS. However, metal/molecule interactions are significantly influenced by atomic local structures of metal surfaces. Unfortunately, it is still difficult to control atomic surface features of such SERS-active substrates. Moreover, most of transition metals are non-plasmonic due to their d-band structure, which is closely related to various functionality such as catalytic activity. These issues seriously limit the capability of SERS to obtain interfacial information in terms of surface science and molecular science.

In this talk, SERS spectroscopy is demonstrated on planar single crystalline metal substrates with atomically defined surfaces. Optical field localization on such a surface is obtained by direct deposition of gold nanoparticles onto molecular monolayers adsorbed on a metal surface so that sphere-plane type nano-gap structures are formed [1]. Moreover, the detectable range of SERS spectroscopy is extended into ultra-low frequency region in order to obtain direct information on intermolecular and metal/molecule interactions [2]. Crystallographic orientation dependence of SERS spectra, measured for thiol/gold interfaces and isocyanide/platinum interfaces, are discussed in terms of molecular adsorption geometries and metal-to-molecule charge transfer resonance transition [2-6]. Unique adsorption behavior at atomic local surface sites is also presented on palladium-modified Au(111) surfaces [7].

References

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BIOGRAPHY

Dr. Ikeda received Doctor of Engineering from Department of Applied Chemistry, The University of Tokyo in 2002. After serving as a postdoctoral researcher at Tokyo Institute of Technology and RIKEN, he became a lecturer in 2006 and promoted to associate professor in 2008 at Hokkaido University and currently a professor of physical science and engineering at Nagoya Institute of Technology since 2015. He is also a group leader in National Institute for Materials Science since 2014 and a visiting scientist in Xiamen University since 2017, and also severed as a visiting scientist at University of California at Berkeley (2003-2005) and RIKEN (2006-2015), and as a PRESTO researcher in JST (2011-2017). He got various awards including Young Scientist Award of Japan Society for Molecular Science (2010), APA prize for young scientists of The Asian and Oceanian Photochemistry Association (2011), Hokkaido University President's Award for Outstanding Research (2013).

His recent research interests include electrochemistry, surface science, and vibrational spectroscopy.

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