北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Weekly Seminar

Heterodyne-detected Vibrational Sum Frequency Generation Spectroscopy
-Determination of molecular orientation and chirality

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Time: 4:00pm, April 13, 2016 (Wednesday)

时间：2016年4月13日 （周三）下午4:00

Venue: Room w563, Physics Building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Vibrational spectroscopy is a powerful tool for studying molecular structures by referring to vibrational spectra. Vibrational spectra sharply reflect molecular conformations and structures and are often called “molecular fingerprint”. Among various vibrational spectroscopies, vibrational sum frequency generation (VSFG) spectroscopy has been widely used to investigate molecules at interfaces. VSFG spectroscopy relies on a second-order nonlinear process such that VSFG signals can be generated only from systems without centro-symmetry such as interfaces and chiral systems. In recent years, heterodyne-detected (HD-) VSFG spectroscopy, which enables us to determine absolute molecular orientations at interfaces, has been developed. HD-VSFG offers the phase of the second-order nonlinear susceptibility ($\chi(2)$), which reflects the absolute molecular orientation, while conventional (homodye-detected) VSFG gives us only $|\chi(2)|2$. HD-VSFG spectroscopy has been applied to several interfaces for the purpose of determining the absolute molecular orientation with high sensitivity. In addition, it has been proven that VSFG spectroscopy can detect optical activity/chirality, chiral VSFG spectroscopy. However, conventional chiral VSFG spectroscopy cannot distinguish molecular chirality because of the loss of information on the phase of $\chi(2)$, which reflects molecular chirality. The heterodyne detection has overcome this advantage and thus enables us to distinguish chirality. Also the heterodyne detection improves the signal to noise ratio, begin capable to detect and distinguish chirality from monolayer systems.
In this talk, the principle and applications of HD-VSFG spectroscopy are the main topics. The idea and the fundamental application to the ionic surfactants adsorbed at the air/water interface are introduced. Then, the basis and several applications of HD-chiral VSFG spectroscopy, which we have developed for the first time, are presented. As an important example, achiral and chiral HD-VSFG study of proteins at the air/water interface will be discussed at last.

About the speaker

Masanari Okuno obtained his B.S. degree in Department of Chemistry, School of Science, University of Tokyo in 2007， and got his Ph.D. degree from University of Tokyo in 2012. From 2009 to 2012, he worked as a postdoctoral Fellow at JSPS (DC1), and then at JSPS for Abroad, Molecular Spectroscopy Department, Max Planck Institute for Polymer Research (supervised by Director Prof. Mischa Bonn) from 2012 to 2013. Since 2013 May, he has been an assistant professor in Department of Chemistry, School of Pure and Applied Sciences, University of Tsukuba.