エクストリームフォトニクスセミナー

Extreme Photonics Seminar

No. 1

Language: Japanese

Date: April 21(Thu), 2011, 15:00 〜 17:00

Location: Cooperation Center, 5F Meeting Room, W524
(研究交流棟5階会議室 W524)

Title: Heterodyne-Detected Second-Order Nonlinear Spectroscopy

Speaker: **山口 祥一 氏** （理研）
Dr. Shoichi Yamaguchi (RIKEN)

"Interface" is now one of the most important keywords in materials and life science. Among a lot of experimental techniques to investigate interfaces, the second-order nonlinear spectroscopy holds a special and unique position that cannot be replaced by the others. One can obtain electronic and vibrational spectra of interfaces noninvasively in the ambient atmosphere by using second harmonic generation (SHG) and vibrational sum frequency generation (VSFG), respectively, which provide essential information for identifying interfacial species, determining structure and orientation, and considering microscopic functions of the interfaces. We recently developed electronic sum frequency generation (ESFG) that can provide electronic $|\chi^{(2)}|^2$ spectra with a much higher signal to noise ratio and far denser spectral data points than SHG.
SHG, VSFG, and ESFG measurements provide data representing $|\chi^{(2)}|^2$, not $\chi^{(2)}$ itself, because of the homodyne nature of signal detection. This feature sometimes makes interpretation of data difficult, and even worse, it hides essential information inherent in $\chi^{(2)}$. The most crucial information lost in the homodyne detection is the sign of $\chi^{(2)}$ that is directly related to the "up" versus "down" alignment of interfacial molecules.
Recently, we have realized the heterodyne detection of ESFG and VSFG. These new methods, HD-ESFG and HD-VSFG, can provide electronic and vibrational complex $\chi^{(2)}$ spectra of interfacial molecules, respectively. We are now studying interesting topics such as absolute orientation of interfacial molecules, pH difference between the aqueous bulk and interface, and higher order structure of proteins adsorbed on interfaces, by using HD-ESFG and HD-VSFG.

Title: Generation of superfine structure smaller than 10 nm by topdown technique

Speaker: **中田 芳樹 氏** (大阪大学レーザーエネルギー学研究センター)
Prof. Yoshiki Nakata (Inst. Laser Eng., Osaka Univ.)

Interfering femtosecond laser can induce periodic induction of energy. When an opaque thin film deposited on a substrate is irradiated by an interfering femtosecond laser, periodic thermal process is induced. This results in liquid motion of the solute film. The process has an analogy with a motion of liquid water taken by a high-speed camera. Each spot melts, inflates, flows and shrinks according to the nature of the solute thin film, then it freeze due to temperature fall by thermal radiation and conduction. The temperature distribution, which governs the natures such as viscosity, surface tension, changes in time and space, but the resultant structures are very simple and unique. The shapes of the structures are bump, spike, waterdrop, and can be controlled by laser fluence, thin film thickness, substrate material, etc.. The size of some structures is smaller than 10 nm in curvature radius, and the aspect ratio is over 20. In addition, an interference pattern changes according to the phase shift and power ratio between the interfering beams, and duplicated structure of two shapes, or complicated structures can be generated in a single shot of laser irradiation. In the case of duplicated structure, the density of nano-structures is doubled, and two different nano-structures appear alternately. These structures will be useful in nanotechnology, metamaterial technology, etc..

連絡先： 高強度軟X線アト秒パルス研究チーム 鍋川 (8538)
Contact: Y. Nabekawa, Intense Attosec. Pulse Res. Team (8538)