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Plasmonic Raman microscopy for nano, 3D, and deep UV imaging

Satoshi Kawata
Osaka University, Japan

Raman microscopy has been getting popular in nanomaterials and biosciences, and industry of advanced materials and devices, as it provides richer information than other imaging techniques without any process to damage samples. However, Raman scattering is a weak phenomenon and the spatial resolution is usually limited by the diffraction of probing light. Both these problems can be overcome with use of a metallic tip, which provides local enhancement of light in the focused light spot [1]. The spatial resolution is limited by the diameter of metallic tip (typically ~10nm) to excite collective electron oscillation as localized mode of surface plasmons at the tip [2]. The factor of Raman scattering is enhanced by the tip due to the plasmon resonance similarly to the mechanism of surface enhanced Raman scattering. The effective spectral range is typically between near UV to near infrared for silver and gold. In this presentation, I will show our research progress in plasmonic Raman microscopy or TERS (tip-enhanced Raman scattering) microscopy beyond the limitations. The spatial resolution has been drastically improved by applying pressure on to the sample with a tip to introduce the localized structural deformation in sample [3]. The broadband enhancement by cascading the probe antennae [4], the deep UV resonant Raman TERS [5], and 3D Raman imaging with a gold nano-particle inside a living cell [6] will be discussed.

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