第78回応用物理学会秋季学術講演会 講演予稿集 (2017 福岡国際会議場)

DUV nano-Raman microscopy with plasmonic tip

Atsushi Taguchi[1], Kohta Saitoh[1,2], Satoshi Kawata[1,2]

[1] Department of Applied Physics, Osaka University, [2] Serendip Research, Ltd.
E-mail: taguchi@ap.eng.osaka-u.ac.jp

Tip-enhanced Raman spectroscopy (TERS) is a unique and indispensable imaging technique which enables analysis of nano-materials with a spatial resolution of a few tens of nanometers together with a strong enhancement of weak Raman signals from the nanometric volume of a sample [1]. The strong enhancement and photon localization is realized with plasmonic metallic tips [2]. While gold and silver, commonly used tip materials, are effective plasmonic metals in the visible wavelengths, in the deep UV (DUV) wavelength region, these metals behave absorptive dielectrics but not as metal. This has limited the use of TERS in the visible wavelengths. However, DUV is an interesting wavelength region in spectroscopy and microscopy because molecules such as nucleotides and proteins show characteristic resonance Raman scatterings, which can be effectively combined with plasmonic tip-enhancement.

With an aluminum tip instead of gold and silver tips, we have demonstrated TERS in the DUV [3]. We reported an enhancement factor of ~1,300 with adenine nanocrystal as a sample, where the resonance Raman scattering of samples were excited with 266 nm laser wavelength [3]. The localized plasmon resonance of aluminum and indium nanoparticles was investigated and shown to have plasmonic resonance in the DUV [4,5].

In this presentation, we will show the results of our recent development of DUV-TERS microscopy. Instrumentations of DUV-TERS microscopy will be shown. The DUV-TERS enhancement of graphene, carbon nanotubes, and adenines will be shown together with metal structures at the tip apex characterized by SEM observations.

References

[1] Satoshi Kawata, Taro Ichimura, Atsushi Taguchi, Yasuaki Kumamoto, Chem. Rev. **117** (2017) 4983.
[2] Atsushi Taguchi, Jun Yu, Prabhat Verma, Satoshi Kawata, Nanoscale **7** (2015) 17424.
[3] Atsushi Taguchi, Norihiko Hayazawa, Kentaro Furusawa, Hidekazu Ishitobi, Satoshi Kawata, J. Raman Spectrosc. **40** (2009) 1324.
[4] Atsushi Taguchi, Yuika Saito, Koichi Watanabe, Song Yujian, Satoshi Kawata, Appl. Phys. Lett. **101** (2012) 081110.
[5] Yasuaki Kumamoto, et al. ACS Photonics **1** (2014) 598.