TIP-ENHANCED NEAR-FIELD CARS MICROSCOPY

Satoshi Kawata
Department of Applied Physics, Osaka University / Nanophotonics Laboratory, RIKEN
Suita, Osaka 565-0871, Japan / Wako, Saitama 351-0198, Japan
E-mail: skawata@skawata.com

Differently from AFM, STM, or SEM, optical microscopy provides a color image of a living biological sample. In particular, Raman scattering contains spectral information of molecular vibration in a sample without a labeling dye. Recently, coherent anti-Stokes Raman scattering (CARS) microscopy has been successfully coupled with laser scanning microscopy for analytical 3D imaging [1,2]. In this presentation, we will talk about CARS imaging of nano-materials. The spatial resolution is far beyond the diffraction limit due to the plasmonic nano-probe [3,4]. A silver coated nano-probe having a sharp apex is employed to locally enhance the excitation fields and the CARS polarizations owing to the local plasmon polaritons launching at the apex [5]. In addition, the third-order nonlinearity of CARS process further confines the photons into a small volume near the tip end. We will show near-field CARS images of DNA molecules and carbon nanotubes of different types. Figure 1 shows a CARS image of self-assembled DNA network at 1337 cm^{-1} representing ring-stretching mode of adenine base. The spatial resolution in the image is estimated to be ~15 nm. Chemical and mechanical near field effects will be also discussed [6,7].

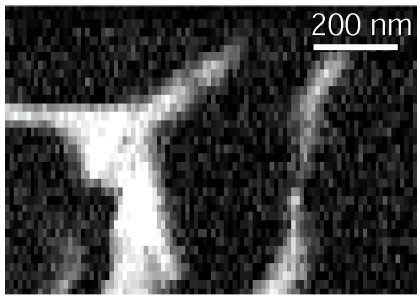

Figure 1: A DNA network visualized by the near-field CARS microscope [4].

References

[1] A. Zumbusch, *et al., Phys. Rev. Lett.* **82,** 4142 (1999).
[2] M. Hashimoto, *et al.*, *Opt. Lett*. **25**, 1768 (2000).
[3] N. Hayazawa, *et al., J. Appl. Phys.* **95**, 2676 (2004).
[4] T. Ichimura, *et al., Phys. Rev. Lett.* **92**, 220801 (2004).
[5] Y. Inouye, *et al.*, *Opt. Lett*. **19**, 159 (1994).
[6] H. Watanabe, *et al.*, *Phys. Rev. B* **69**, 155418 (2004).
[7] H. Watanabe, *et al.*, *J. Phys. Chem. B*, in press.