

MULTIPLEX MULTI-FOCUS COHERENT ANTI-STOKES RAMAN SCATTERING MICROSCOPY

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Label-free real-time imaging of living cells is greatly desired for the elucidating of biological events and processes in the cells. CARS (coherent anti-Stokes Raman scattering) microscopy is a powerful tool for high-speed imaging of the living cells without staining^[1, 2, 3]. For the high-speed multi-spectral imaging of molecular distributions and reactions, we have developed a multiplex multi-focus CARS microscope using a microlens array scanner and an AOTF (acousto-optic tunable filter)^[4].

Figure 1 shows the developed CARS microscopy system. As light source, highly synchronized ps (ω_1 light) and fs (ω_2 light) Ti:sapphire lasers were used, and the beams were split into multiple beamlets by a rotating microlens array disk to excite multiple points of a specimen through a multiplex CARS process simultaneously. The observed wavelength of the CARS signal was selectively filtered with the AOTF, and the CARS image was detected by an image sensor.

We demonstrated realtime multi-spectral CARS imaging of polystyrene beads (Fig. 2). The observed Raman shift was scanned through 980 cm^{-1} to 1020 cm^{-1} . The image acquisition rate was 200 ms/image, and the spectrum was constructed from the CARS images.

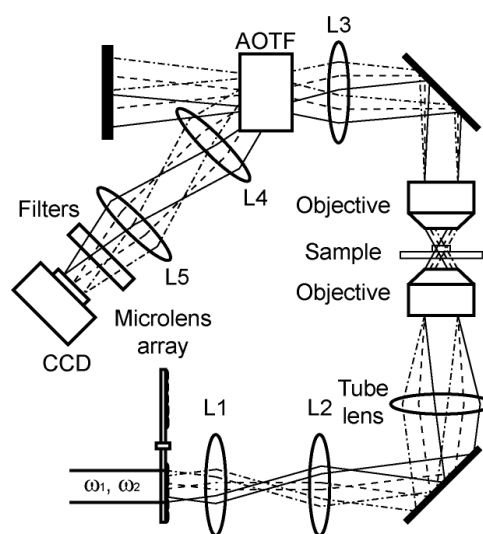


Fig. 1 Optical setup.

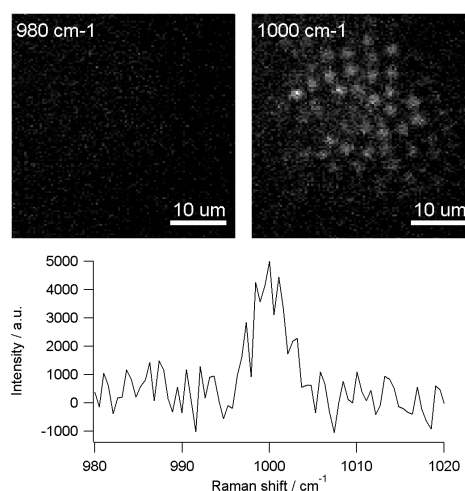


Fig. 2 Multiplex multi-focus CARS images of polystyrene beads.

[1] A. Zumbusch et al., Phys. Rev. Lett., **82**, p.4142 (1999). [2] M. Hashimoto et al., Opt. Lett., **25**, p.1768 (2000). [3] T. Minamikawa, Proc. Focus on Microscopy, p.84 (2008). [4] M. Hashimoto et al. Proc. SPIE (BiOS 2009), **7183**, (in press).