

Endocytosed metallic nanoparticles for Raman analysis of intracellular biomolecules

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Metallic nanoparticles enhance Raman scattering from molecules near a metal surface, and there have been many attempts to apply enhanced Raman spectroscopy for high sensitive detection of biomolecules^{1,2}.

We introduced gold nanoparticles into living macrophage cells by endocytosis. Motions of nanoparticles in the cell and enhanced Raman scattering from molecules around particles were simultaneously observed. The coordinate of particle is obtained by dark-field microscopy, and the position of the laser focus for Raman spectroscopy is controlled by a feedback system. Figure (a) shows dark-field image of macrophage cell, cultured with 50 nm of gold nanoparticles for 3 hours. Bright spots indicate gold nanoparticles in the cell. Figure (b) shows typical trajectory of gold nanoparticles for 30 seconds with temporal resolution of 60 ms, observed in same sample shown in Figure (a). Trajectories of nanoparticles showed several types of particle motions: straightforward, confined motions and simple diffusion. From simultaneous measurement of particle motion and enhanced Raman scattering from a particle, we found out that Raman spectra changed depending on the motions of particle. During straightforward motions, Raman bands, which can be assigned to be proteins, is frequently observed. Once straightforward motion stopped and showed confined motion, Raman spectra also changed. In general, endocytosed nanoparticles are entrapped by vesicles, transported via transportation proteins, and accumulated in lysosomes for digestion. Motion dependent spectral change observed here indicates that enhanced Raman scattering may detect biomolecules involved in cellular functions, such as organelle transportation or lysosomes accumulations.

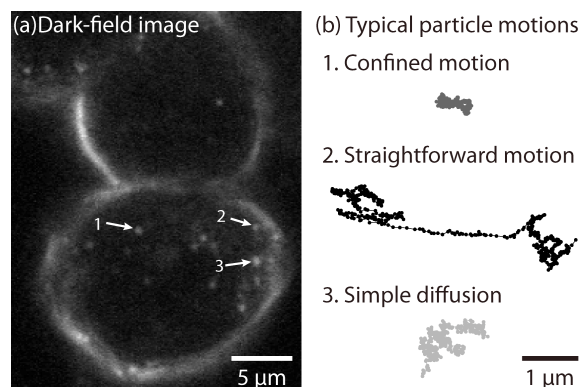


Figure (a) Dark-field image of macrophage cultured with 50nm of gold nanoparticles (b) Typical particle motions in cell, showing confined, straightforward, and simple diffusion

References [1] K. Fujita et al., *J. Biomed. Opt.*, **14** 024038 (2009). [2] K. Fujita, J. Ando et al., *Proc. of SPIE BiOS*, **7192** 71920Q (2009)