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光トラップによる銀ナノ粒子凝集体の作製と生体分子の SERS 解析

Fabrication of silver nanoparticle aggregates by using optical trap and SERS analysis of biomolecules

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Noble metal nanoparticles exhibit extremely interesting optical responses in interaction with light. Surface-enhanced Raman spectroscopy (SERS) is an enhanced Raman scattering from molecules adsorbed on noble metal nanostructures. The enhancement factor can be as much as 10^{14}, which means the technique may detect single molecules. Not only size and shape of individual nanoparticle, but also aggregation structures are significant for sensitive SERS detection. In this work, silver nanoparticles with high SERS sensitivity were synthesized by original seed mediated method. Optical trapping technique was used to make SERS-active aggregates in colloidal silver solution in the presence of analyte molecules. The aggregates produced by optical trapping could be fixed on a glass substrate and the SERS spectra were measured by irradiating a visible laser beam on it.

Silver nanoparticles including triangular particles were synthesized by seed mediated method with citrate and ascorbic acids. Analyte molecules were mixed in the silver colloid just before the SERS measurement. The mixed solution was put into the gap between a glass slide and a polymer plate. An IR laser beam (1064nm) was focused in the solution via an objective lens (100x, NA=1.3) for optical trapping. The trapped aggregates were fixed on substrate by approaching the focal point to substrate. A visible laser beam (532nm) was irradiated on the fixed aggregates and SERS spectra were measured by a spectrometer. Fig 1 shows the SERS spectra of adenine at different concentrations. We have succeeded to detect 10^{-8} M adenine and 10^{-7} M histamine by using this method.

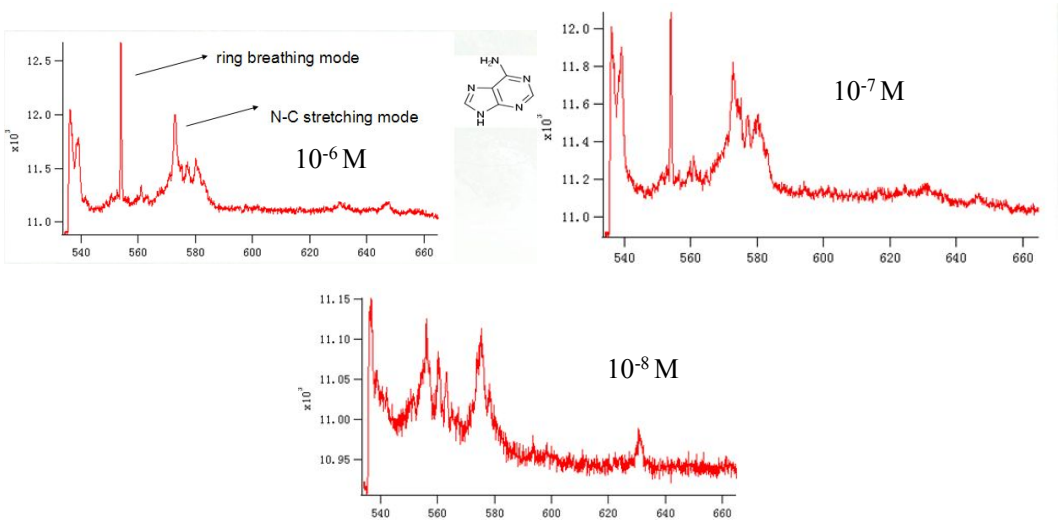

Fig 1. SERS spectra of adenine adsorbed on SERS-active silver anoaggregates.

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