

Centrifuge classification of citrate-stabilized silver nanoparticles and their application to SERS substrates

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Surface-enhanced Raman scattering (SERS) has attracted attention as a practical ultra-sensitive detection of harmful chemicals and biomarkers. SERS effect is affected by the composition and morphology of the plasmonic nanostructures. In particular, silver nanoparticles (AgNPs) are well known as an excellent SERS material¹, and are desired to improve their shape and size uniformity without ligands as SERS noise source. In this study, citrate-stabilized silver nanoparticles² were purified using a stepwise centrifuge classification method³. In addition, these purified silver nanoparticles were evaluated by their SERS performance.

The stepwise centrifuge classification method is the process repeating centrifugation and redispersion as one step (Fig.1). The centrifugation time increases by 5 minutes as the number of the step increases. The classified AgNPs obtained from the bottom of the centrifugation tube did not fuse, and their average diameter gradually decreased with increasing of the number of steps. (Fig.2). Dynamic light scattering properties and absorption spectra of the classified AgNPs indicated that the size uniformity was improved by the classification process. The classified AgNPs were adsorbed on an amino group modified slide-glass. AgNPs on the glass substrates were evaluated by SERS spectra of rhodamine 6G. Some of the Raman scattering spectra indicated the thermal decomposition of the dye. Based on the results, the interrelationship among the SERS effect, the localized heat generated on the AgNPs, and the shape and size of the AgNPs was discussed.

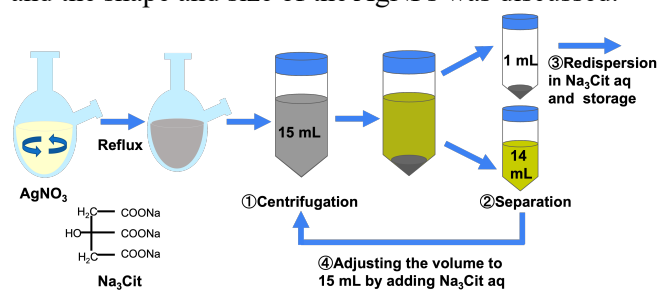


Fig. 1 The diagram of the stepwise centrifuge classification method.

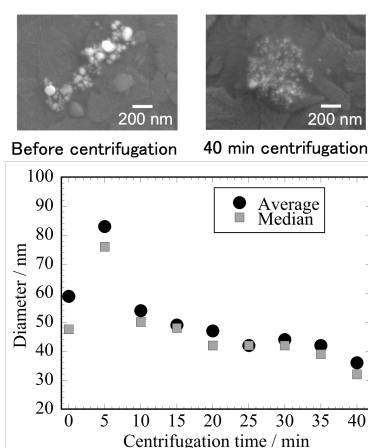


Fig. 2 SEM images and diameter of the AgNPs for centrifugation time.

- 1) S. Nie, S. Emory, *Science*, **1997**, 275, 1102.
- 2) P. C. Lee, D. Meisel, *J. Phys. Chem.*, **1982**, 86, 3391.
- 3) N. Koyama, T. Akiyama, T. Oku, *Jpn. J. Appl. Phys.*, **2021**, 60, 027002.