

Particle diameter distribution of subnano gold particles using the small-angle X-ray scattering method

Introduction

By using the small-angle X-ray scattering method, it is possible to evaluate the size distribution of powders, microparticles dispersed in liquid, and particles/pores distributed in thin films. In particular, it is possible to evaluate the average size and distribution of sub-nanometer particles, which are difficult to evaluate with a TEM (Transmission Electron Microscope) or DLS (Dynamic Light Scattering). In this case, we evaluated the size distribution of gold nanoparticles dispersed in organic solvent.

Measurements and results

Fig. 1 shows the measurement results for gold nanoparticles dispersed in organic solvent. Fig. 2 shows the particle diameter distribution, estimated based on the results of small-angle X-ray scattering measurement, overlaid on the results (histogram) estimated from TEM observation.

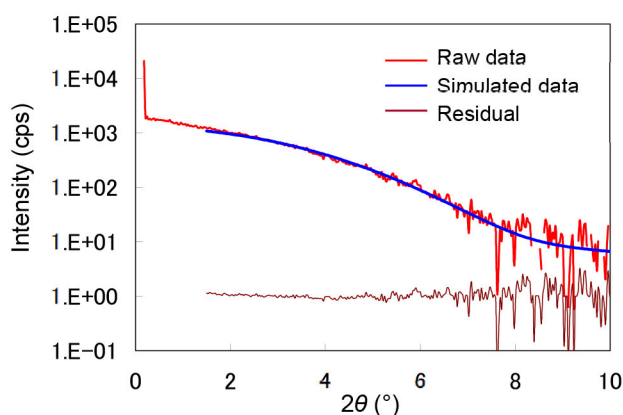


Fig. 1: Results of small-angle X-ray scattering measurement of gold nanoparticles dispersed in organic solvent

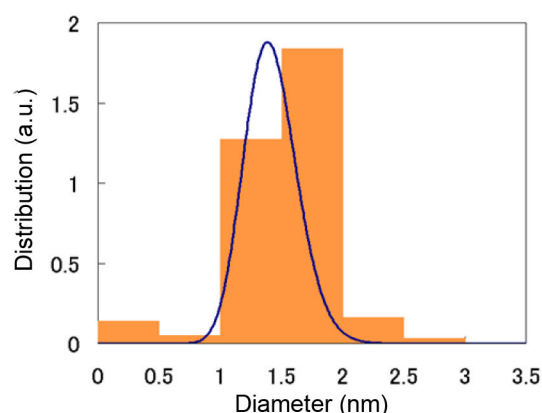


Fig. 2: Particle diameter distributions based on small-angle X-ray scattering and TEM observation

Fig. 3 shows the results of measuring small gold nanoparticles, and Fig. 4 the particle grain distribution estimated from that profile. It is difficult to evaluate the size distribution of sub-nanometer order particles via TEM observation, and the small-angle X-ray scattering method has good potential as a new evaluation method for this size domain.

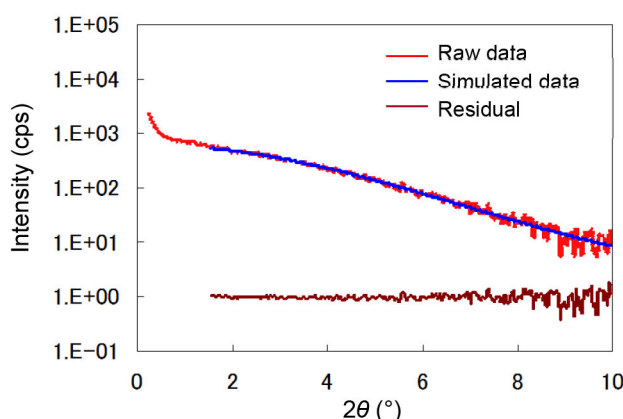


Fig. 3: Results of small-angle X-ray scattering measurement of gold nanoparticles

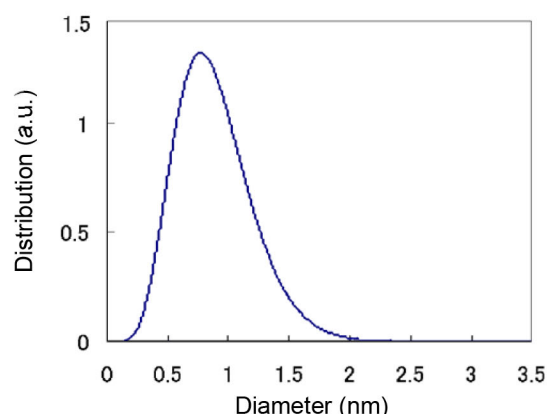


Fig. 4: Particle diameter distribution of gold nanoparticles

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Recommended equipment and software

- ▶ Theta-Theta Type X-ray Diffractometer Ultima IV
- ▶ Particle-/Pore-size Analysis Software NANO-Solver
- ▶ Automated Multipurpose X-ray Diffractometer SmartLab®