Type of presentation: Poster

ID-9-P-3016 Particle analysis of TEM/SEM images of nano-particles

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Nano-particles are becoming widely used as functional materials. As a result, the technology to measure the size distribution of nano-particles is required. Direct observation with TEM or SEM is used for it; but, such methods are problematic because 1) the field of view of the target is limited, and 2) the measurement results depend on operator. The purpose of this study was to devise a way to solve these problems, in which samples are observed with TEM or SEM automatically (or manually), discrimination of individual nano-particles is made automatically from the image, and the size distribution is determined. As the first stage, to distinguish between adjacent particles we developed a nano-particle analysis system using the Mean Shift method, a segmentation method for image.

For the nano-particles, two types of polystyrene latex (PSL) standard spheres (30 nm, 260 nm) were used. After dispersing these nano-particles in a solution, the samples were observed using TEM and SEM. The analysis system we developed was used to determine the average particle size and size distribution from the acquired images, and the performance of the analysis system was evaluated. A JEM-1400Plus (JEOL) was used to make the TEM observations, and a JSM-7100F-TTL (JEOL) was used for the SEM observations. STEM observations were made using the SEM instrument.

Fig. 1 shows the TEM image of the PSL standard spheres (260 nm). Fig. 2 shows the results of the segmentation of adjacent particles using the Mean Shift method. The detected average particle diameter was 258 nm, with a standard deviation of 4 nm. Fig. 3 shows the STEM image acquired with the SEM for the PSL standard spheres (30 nm). Fig. 4 shows the results of the segmentation of adjacent particles using the Mean Shift method. The detected average particle diameter was 26 nm, with a standard deviation of 7 nm. This indicates that the standard deviation differs according to the diameter of the standard sphere, suggesting that can be attributed to the classification accuracy of the standard spheres and the conditions of the particle aggregation. When using Mean Shift to perform the segmentation, the determination of the boundaries makes use of the brightness profile between the particles and substrate, which is affected by the how the particles clump together. Therefore, if a method for determining the particle-substrate boundaries that accurately reflects the true particle diameter can be established, it will be possible to use this method to measure particle diameters with a higher accuracy than the conventional methods.

References

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2) P. Meer, B. Georgescu: IEEE Trans. Pattern Analysis. Machine Intelligence, 23, 1351 (2001).

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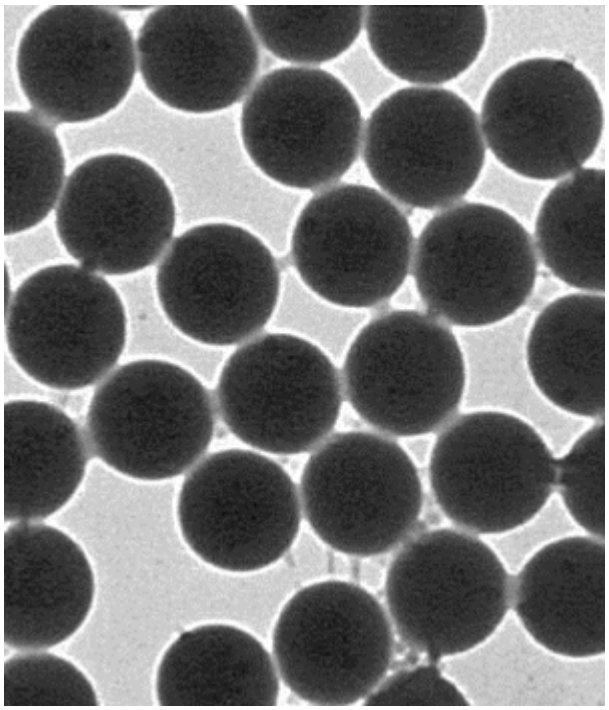

Fig. 1: TEM image of PSL (260 nm). Acc. Volt. 120kV.

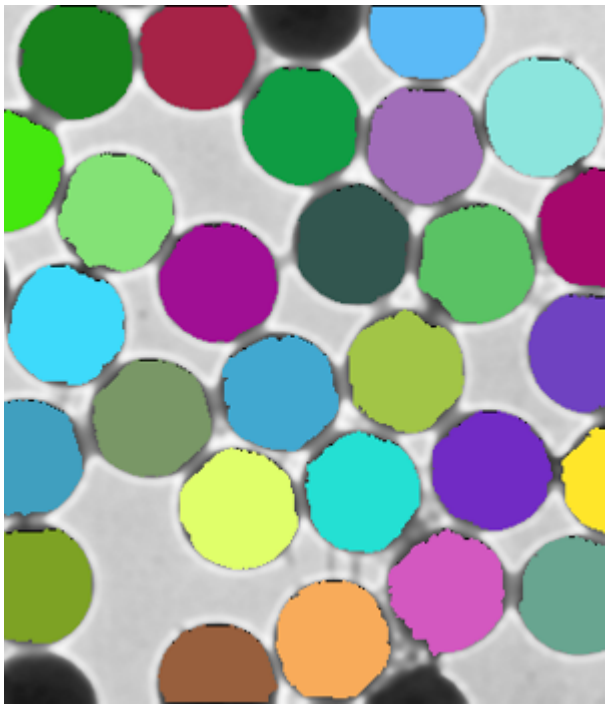

Fig. 2: Segmentation result of TEM image.

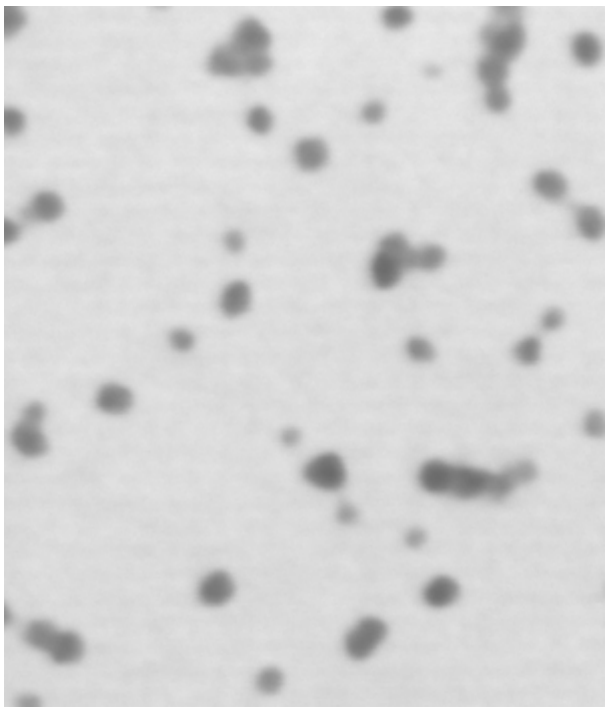

Fig. 3: STEM (SEM) image of PSL (30 nm). Acc. Volt. 20kV.

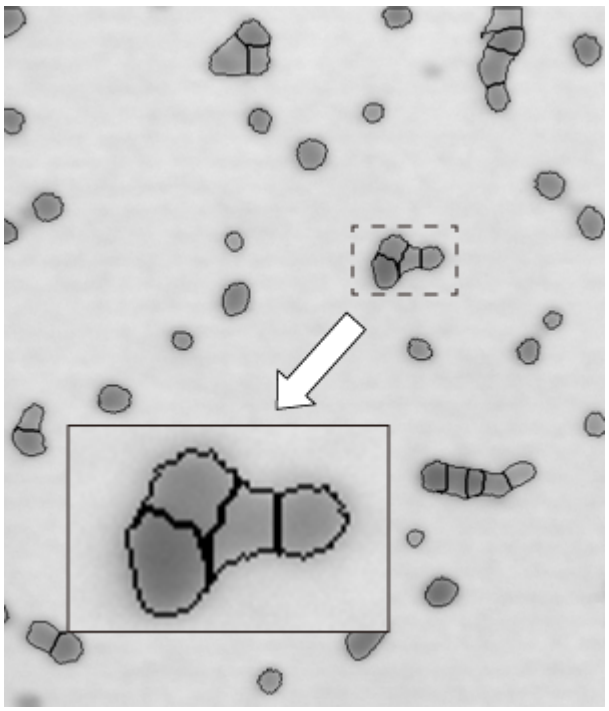

Fig. 4: Segmentation result of STEM image.