

Analysis of the Dispersed State of Graphene Oxide (Mixed)

Outline

Graphene oxide is a nanocarbon material with a high aspect ratio and a high surface area with a thickness of about 1 nm and a sheet length of several to tens of microns. It has a flake-like structure with abundant oxygen functional groups and has a «high dispersibility» that is not available with other nanocarbon materials (carbon nanotubes and graphene) so far. This makes it easy to combine with various materials and can be used as a coating film or functional film. In recent years, it has been studied for applications in next-generation battery materials, antibacterial and antiviral substances, coatings, lubricants, water purification, catalysts, and other functional materials.

Due to its high aspect ratio and high dispersibility, graphene oxide forms a network in the host material when a small amount is added. For various host materials, different functions are expressed when added. In addition, since a network of graphene oxide can be formed even in very thin films, it is also suitable for use in membranes and in film shapes.

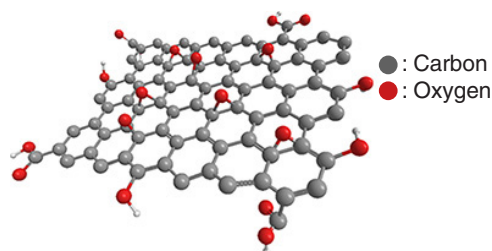


Fig. 1 Molecular structure of graphene oxide
Source: Molecular structure is used with permission from NIPPON SHOKUBAI Co., Ltd.

Method

Apparatus: HORIBA Partica CENTRIFUGE
Measurement mode: Line-start
Sample volume: 40 μ L
Samples: Graphene oxide aqueous solution (Solid concentration: 2 mg/mL)
Calibration sample: Thermo Fisher Scientific_No.8100: Silica/Deionized water, Nominal size: 1.0 μ m, Mean: 0.99 μ m, Density: 2,010 kg/m³
Particle: Graphene oxide (Refractive index: 1.84 – 0.6i, Density: 2,260 kg/m³)

Medium: 8-24% sucrose density gradient solution (Average Refractive index: 1.352, Average density: 1,048 kg/m³)
Particle size distribution (PSD) base: Volume based
Calculation setting: Custom mode
Extinction coefficient correction: OFF
Smoothing : 3

Results

Fig. 2 shows the PSD measured by Partica CENTRIFUGE calculated without extinction coefficient correction, having a median diameter of 0.366 μ m and a mean diameter 0.896 μ m. Three dispersion states have been observed: isolated, bundled, and aggregated states.

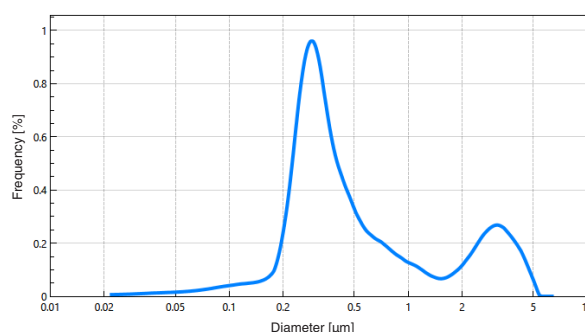


Fig. 2 Volume-based PSD

Conclusion

Although water dispersibility, which was difficult with graphene and other nanocarbon materials, has been improved, the measurement result of this graphene oxide dispersion still shows three states: isolated, bundled state, and aggregated state, with a wide particle size distribution. In addition, when absorbance correction set ON, quantitative calculation has been improved, and the blending ratio of each dispersion state can be understood. This method can be used for the dispersion state evaluation of graphene.