Nanotechnology Letters

Extended Abstract
Vol. 3, Iss. 2
2018

NanoMat 2018: Characterization of nanomaterials using field-flow fractionation - Haruhisa Kato - National Metrology Institute of Japan - AIST, Japan

Haruhisa Kato
National Metrology Institute of Japan - AIST, Japan

Size and size distribution are significant physicochemical properties of bio and functional materials since it determines many of the functional properties of these materials. Methods for the accurate determination of the size and the size distribution of materials are therefore one of the key to the development of nano and biotechnologies. In the past few decades, dynamic light scattering (DLS) and particle tracking analysis (PTA) have been widely used for determining the sizes of Brownian nanoparticles in nano and submicron scale biocolloidal suspensions. Because of the convenience and usability of DLS, a large number of commercial instruments and analytical methods based on various principles underlying the DLS method are available. In DLS and PTA analysis, the diffusion coefficients of nanomaterials are determined first, after which the averaged diameters of the particles are calculated from the diffusion coefficients by using the Stokes– Einstein relationship. However, the apparent diameters of nanoparticles over a wide size distribution as determined using such diffusion based analysis method depends on the particular analytical algorism. Electron microscope is an effective method to obtain the primary particle information visually, however; it requires counting a large number of materials for ensemble characterization. Additionally, the European Commission has declared that a nanomaterial is a natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50% or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm–100 nm. According to this definition, not only the size but also the size distribution of nanomaterials in is an important factor for nanomaterial industrial field. Fractionation methods such as field-flow fractionation (FFF) and microfluidic/nanofluidic technological separation have recently been focused upon as methods for the determination of accurate size distribution. FFF is elution techniques wherein nanoparticles, microparticles, and macromolecules are separated by their physicochemical properties. In nano and micro technology, various FFF methods are attractive techniques for separating materials in colloidal dispersions by means of flow, centrifugal, magnetic, and thermal field control. Different fields enable nanoparticle separation based on various criteria: diffusion coefficient (i.e. hydrodynamic size) by flow FFF, thermal diffusion coefficient, density, mass, and so forth. The most general applicable FFF methods are flow FFF and centrifugal FFF because of their practicality and the robust theoretical foundation established for separation of nano and micro materials in many areas. Herein, we performed FFF assessments of various materials combined with DLS and EM methods to characterize more accurate size and size distribution of materials than the results by single sizing method such as DLS. This study plays an important role in producing a new application of nano and biotechnology.

This work is partly presented at 17th Edition of International Conference on Emerging Trends in Materials Science and Nanotechnology, April 26-27, 2018 held at Rome, Italy