Separation and Characterization of Nanoparticles Using Field-Flow Fractionation and Other Methods

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Analytical techniques are continuously challenged by the advent of new materials designed to achieve enhanced properties and performance. These materials are often complex mixtures of nanoparticles, polymers, or nanocomposites with distributions in size, shape, composition, etc. The measurement of these distributions is important in establishing property-performance relationships and in determining the presence of small subsets of detrimental outliers. Nanoparticle analyses are performed using ensemble (non-fractionation) or fractionation methods. The former yield average values representative of the entire sample while the latter provides detailed information about relative amounts of nanoparticles of each size, shape, etc.

One example of a fractionation method is the family of field-flow fractionation (FFF) techniques. The separation process occurs in open channels devoid of packing materials, thus making FFF suitable for separations of macromolecules, nanoparticles, and micron-sized particles. In practice, this translates to a very wide size range (nanometers to micrometers) that can be injected into a single FFF channel and the ability to analyze an entire sample without the need to prefilter. Depending on the type of FFF that is used, separations can be performed on the basis of size, mass, chemical composition, and microstructure. In many cases, established theory can be used to relate retention times to physicochemical properties of the sample.

This presentation will address general differences in non-fractionation and fractionation methods for characterizing nanoparticles with a major emphasis on FFF applications to nanoparticles and polymers.