Review

Density gradient ultracentrifugation for colloidal nanostructures separation and investigation

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Abstract

In this article, we review the advancement in nanoseparation and concomitant purification of nanoparticles (NPs) by using density gradient ultracentrifugation technique (DGUC) and demonstrated by taking several typical examples. Study emphasizes the conceptual advances in classification, mechanism of DGUC and synthesis-structure-property relationships of NPs to provide the significant clue for the further synthesis optimization. Separation, concentration, and purification of NPs by DGUC can be achieved at the same time by introducing the water/oil interfaces into the separation chamber. We can develop an efficient method “lab in a tube” by introducing a reaction zone or an assembly zone in the gradient to find the surface reaction and assembly mechanism of NPs since the reaction time can be precisely controlled and the chemical environment change can be extremely fast. Finally, to achieve the best separation parameters for the colloidal systems, we gave the mathematical descriptions and computational optimized models as a new direction for making practicable and predictable DGUC separation method. Thus, it can be helpful for an efficient separation as well as for the synthesis optimization, assembly and surface reactions as a potential cornerstone for the future development in the nanotechnology and this review can be served as a plethora of advanced notes on the DGUC separation method.

Keywords: density gradient ultracentrifugation, isopycnic separation, rate zonal separation, colloidal nanostructure, nanoseparation.