Priority Research Direction

Mesoscopic Perspectives in Separations Science

Opportunity

Solvent extraction, the paramount metal separations method for rare metals refining and advanced energy systems, involves surfactant molecules dissolved in oil. These self-assemble into reverse micelles that, in turn, assemble into larger, higher-ordered solution architectures. The impact of this mesoscopic behavior is poorly understood and likely has far-reaching consequences on practical process systems.

Meso Challenge

(1) Identify the architectures and driving mechanisms underpinning mesoscopic ordering phenomena; (2) relate this to macroscopic solvent-extraction properties; (3) deliberately control meso behaviors to maximize metals separation efficacy.

R. J. Ellis and M. R. Antonio, *Coordination Structures and Supramolecular Architectures in a Cerium(III)-Malonamide Solvent Extraction System*, Langmuir, 28, 5987, (2012)

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Approach

The behavior of mesoscopic assemblies in solvent extraction systems is dynamic. Diverse architectures form spontaneously in solution and metamorphose drastically with small changes in solution properties, notably temperature and acidity. These structural correlations appear to have unprecedented impact on macroscopic behaviors. By linking the atomic to the meso and the macro, a deeper understanding and control of solvent extraction systems will be achieved.

Impact

Understanding mesoscopic behavior in solvent extraction promises a direct impact on improving the efficacy of process technology and, therefore, the economies that depend on advanced and high-performance energy systems. Moreover, understanding self-self assembling solution architectures is of key importance in developing the underlying mesoscopic science in nano-synthesis, colloid chemistry, biology, and other areas.