Diluent-free extraction process based on quaternary ammonium ionic-liquid for uranium recovery

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Solvent extraction remains central to uranium hydrometallurgy, particularly from sulphuric acid leachates, where the AMEX (Amines Extraction) process using trialkylamines in organic diluents dominates.[1] However, challenges such as volatility, limited selectivity, and third-phase formation continue to hinder current processes. We developed a diluent-free extraction system based on ionic liquids type ligands, inspired by the in situ formation of ammonium salts in the AMEX process. By combining protonated trioctylamine salts with hydrophilic (SO_4^{2-}, Cl^-) and hydrophobic (NTf_2^-) anions, we obtained a tunable extractant phase with suitable viscosity and high uranium loading capacity.[2]

A combination of experimental techniques (EXAFS, SAXS, SANS, UV-Vis) and molecular dynamics simulations was used to investigate the mechanism of uranium extraction in the liquid ionic system, revealing the significant impact of water co-extraction on both uranium separation and physico-chemical properties of the ionic liquid phase.[3] Structural analysis confirmed that uranyl complexes are coordinated by three sulphate anions and also reveal a long-range structure in which all anions are separated by at least one cation, forming an anionic grid. This system represents a promising, greener alternative for uranium recovery while offering new mechanistic insights.

References

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