

Surfactant-modified Silica Nanoparticles for Rare Earth Element Separation via Froth Flotation

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Rare earth elements are new resources for clean energies

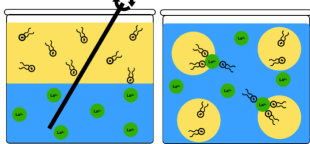


"REE's" and their markets. OD6 Metals Ltd

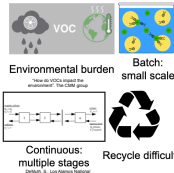


"What are Rare Earth Elements". eurare.org

Current separation method has several limitations



Liquid-liquid Extraction

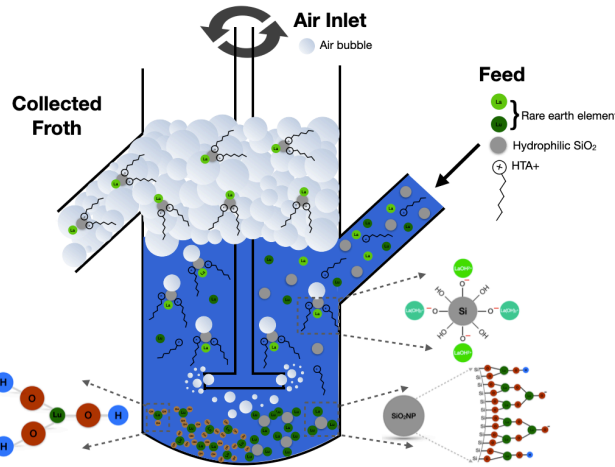


Batch: small scale
Continuous: multiple stages
Recycle difficulty

Introduction

REE: Particle Interaction

Rare Earth Element Froth Flotation

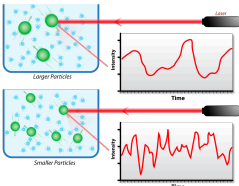


- Elimination of organic phase
- Continuous Process
- Easy stripping of REE
- Recovery of SiO₂NPs

Experimental Method

Froth Flotation Results

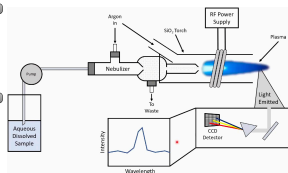
Dynamic Light Scattering



Dynamic light scattering. Wikipedia

- Zeta potential (particle charge density)
- Particle size
- Polydispersity

Inductively Coupled Plasma Optical Emission Spectrometry



Neale, Z., University of Washington, 2020.

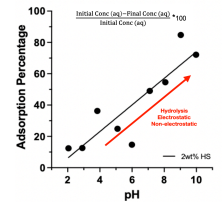
- Quantitative and qualitative element analysis

Goniometer

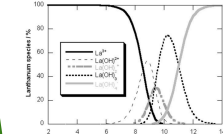


- Surface activity measurements

Lanthanum adsorption onto SiO₂NPs at different pH

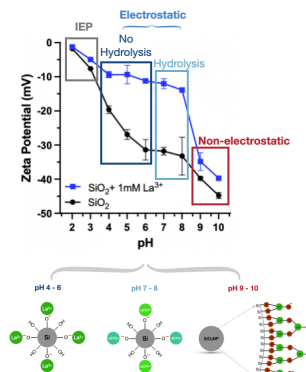


Lanthanum hydrolytic species at different pH

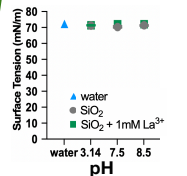


Boayer F., New J. Chem., 2006, 30, 399-408

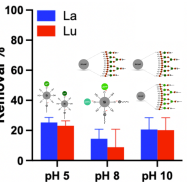
Different types of La: SiO₂NP interactions



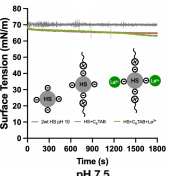
La has a negligible effect on SiO₂NP surface activity



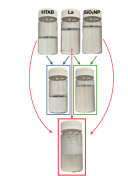
Removal percentage at different pH



Surfactants render La: SiO₂NP hydrophobicity



Surfactants:La: SiO₂NP create foams



REE can be released from SiO₂NP by decreasing pH

