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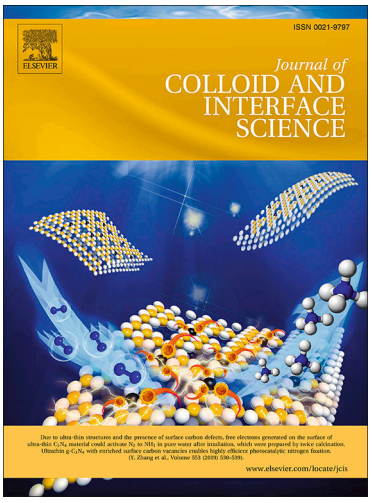

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Salt-Driven Assembly of Magnetic Silica Microbeads with Tunable Porosity

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Abstract

Hypothesis

Porous magnetic silica beads are promising materials for biological and environmental applications due to their enhanced adsorption and ease of recovery. This work aims to develop a new, inexpensive and environmentally friendly approach based on agglomeration of nanoparticles in aqueous droplets. The use of an emulsion as a geometrical constraint is expected to result in the formation of spherical beads with tunable composition depending on the aqueous phase content.

Experiments

Magnetic silica beads are produced at room temperature by colloidal destabilization induced by addition of $CaCl_2$ to a water-in-oil emulsion containing SiO_2 and Fe_3O_4 nanoparticles. The impact of the salt concentration, emulsification method, concentration of hydrophobic surfactant as well as silica content is presented in this paper.

Findings

This method enables the production of spherical beads with diameters between 1 and 9 µm. The incorporation of magnetic nanoparticles inside the bead's structure is confirmed using Energy Dispersive X-ray spectrometry (EDX) and Scanning Transmission Electron Microscopy (STEM) and results in the production of magnetic responsive beads with a preparation yield up to 84%. By incorporating the surfactant Span 80 in the oil phase it is possible to tune the roughness and porosity of the beads.