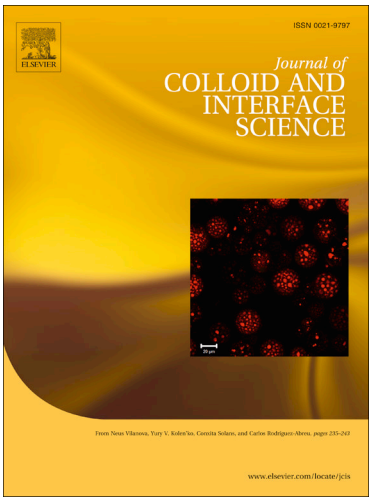

Regular Article

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Synthesis of Nickel Entities: From Highly Stable Zerovalent Nanoclusters to Nanowires. Growth Control and Catalytic Behavior

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Abstract

Non-noble metal nanoclusters synthesis is receiving increased attention due to their unique catalytic properties and lower cost. Herein, the synthesis of ligand-free Ni nanoclusters with an average diameter of 0.7 nm corresponding to a structure of 13 atoms is presented; they exhibit a zero-valence state and a high stability toward oxidation and thermal treatment. The nanoclusters formation method consists in the electroreduction of nickel ions inside an ordered mesoporous alumina; also, by increasing the current density, other structures can be obtained reaching to nanowires of 10 nm diameter. A seed-mediated mechanism is proposed to explain the growth to nanowires inside these mesoporous cavities. The size dependence on the catalytic behavior of these entities is illustrated by studying the reduction of methylene blue where the nanoclusters show an outstanding performance.

Keywords

Nickel nanoclusters; Zero-valence Nickel; Growth mechanism; Nickel Nanowires; EXAFS and XANES characterization; Catalytic methylene blue reduction

1. Introduction

Metal nanoclusters (NC) are a new class of materials which attract a great interest due to their new properties, related to their unique geometric and electronic structures.[1–4] The intrinsic features of these entities do not change monotonically; therefore, the controlled synthesis of these assemblies is highly relevant.