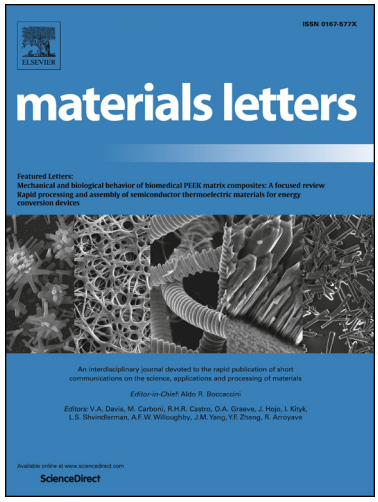

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Sustainable Batch Production of Biosynthesized Nanoparticles

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Abstract

The production of biosynthesized nanoparticles is a slow process with complex isolation and collection procedures due to adhesion to the cell surface. Isolating the microorganism by immobilization in alginate beads will allow for easier recovery of nanoparticles. Immobilized Clostridium pasteurianum was able to reduce Pd ions efficiently through multiple batch production cycles with an average of 99.5% reduction in the metal ions. Microscopic imaging, diffraction and spectroscopic analyses of the Pd nanoparticles formed using immobilized cultures showed similar size distribution to particles collected from suspended cultures and confirmed the particles were metallic Pd. The Pd nanoparticles also retained their catalytic activity, as shown through the reduction of 450 μM methyl orange in less time than the controls. These results demonstrate the effectiveness of the immobilization method for batch production of biosynthesized nanoparticles with little to no difference in particle size and properties.

Keywords

Nanoparticles, Immobilization, Biosynthesis, Alginate

1. Introduction

The biosynthesis of nanoparticles (bio-NPs) has accrued interest as a relatively simple, sustainable, and environmentally friendly method for the production of nanoparticles [1]. Biosynthesis processes can make use of plant extracts, bacteria, bacterial extracts, enzymes, and fungi in place of dangerous chemicals [1-5]. Bio-NPs have been shown to exhibit higher catalytic reactivity and greater specific surface area compared to nanoparticles synthesized through chemical methods [6, 7]. However, more research is needed in order to improve the production and application of biosynthesized nanoparticles. Production rates of bio-NPs can be impacted due to toxicity levels from the nanoparticles on the microorganisms at increased