Abstract

Nanotechnology, the science and art of manipulating matter at the atomic and molecular level, is increasingly playing an important role in the undergraduate curriculum, but there are few laboratory exercises that emphasize the connection between fundamental nanoscience and larger societal issues with practical applications. A laboratory experiment is described in which students synthesized palladium nanoparticles (PdNPs) and utilized the particles for catalytic reduction of Cr(VI) to Cr(III) in the presence of formic acid. This experiment requires two 3-h laboratory periods and can be adapted for upper-division undergraduate students in instrumental analysis, materials science, or physical chemistry laboratories. During the first laboratory period, students synthesized and characterized PdNPs using TEM and UV-vis spectroscopy. During the second lab period, they utilized the nanoparticles for the catalytic reduction of Cr(VI) to Cr(III) using environmental NIST standard reference soil matrices. Students (98%) successfully prepared the black palladium nanoparticles within the first 3-h period. The students' results yielded 93.30 ± 4.11% conversion of Cr(VI) to Cr(III) using PdNPs and formic acid, compared to <15% when formic acid was used alone. This experiment introduces students to the practical applications of nanotechnology while reinforcing basic chemical principles and instrumental techniques.