Stevens Institute of Technology

Nanotechnology Graduate Program

The impact of stabilized and non-stabilized nickel hydroxide nanoparticles on mesquite plants

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Nanomaterials are of particular interest in environmental chemistry due to their multiple applications and unknown impact on living organisms. In this study, mesquite (Prosopis sp.) plants were treated with 0.01 g, 0.05 g, and 0.10 g of three types of Ni(OH)2 nanoparticles in hydroponics. The nanoparticles were synthesized titrating an aqueous solution of Ni(NO3)2 with sodium hydroxide. The first set included non-stabilized Ni(OH)2 nanoparticles of an average size of 8.7 nm. The second set was nanoparticles with an average size of 0.9 nm stabilized with sodium citrate after the titration. The third set consisted of nanoparticles with an average size of 2.5 nm stabilized with sodium citrate before the precipitation of the Ni(OH)2. The mesquite plants showed little to no effects on the root and shoot elongation or chlorophyll production. The ICP-OES determinations showed that plants treated with 0.10 g of non-stabilized nanoparticles (8.7 nm) had 38182, 1484, and 803 mg/kg DW of Ni in roots, stems, and leaves, respectively. Plants treated with 0.10 g, of nanoparticles stabilized before precipitation (2.5 nm) had concentrations of 11431, 1021, and 400 mg/kg in roots, stems and leaves, respectively. While plants treated with 0.10 g of nanoparticles stabilized after titration (0.9 nm) showed nickel concentrations of 12988, 642, and 315 mg/kg in roots, stems, and leaves, respectively. The XAS analysis showed the presence of Ni(OH)2 nanoparticles in roots and stems of plants treated with non-stabilized (8.7 nm) nanoparticles; while a nickel(II) organic acid type complex was observed in leaves. However, all plants treated with stabilized nanoparticles (0.9 nm and 2.5 nm) show Ni(OH)2 nanoparticles in roots and a nickel(II) organic acid complex in stems and leaves.

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