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Synthesis and characterization of hematite nanoparticles for arsenite removal from aqueous medium

Herlys Viltres Cobas[1], **Oscar F Odio Chacon**[2], **Susel Del Sol Fernandez**[1], **Raul Borja Urby**[3] and **Edilso Reguera Ruiz**[1]
[1]Centro de Investigación en Ciencia Aplicada y Tecnología Avanzada, Mexico
[2]Instituto de Ciencia y Tecnología de Materiales, Cuba
[3]Centro de Nanociencias y Micro y Nanotecnologías, Mexico

Arsenic-contaminated groundwater, used as drinking water, has been creating several problems in different countries around the World. The present existing reports of diverse countries showed arsenic concentrations in drinking water is much higher than those proposed by the World Health Organization (10 μg/L). Nanomaterials and nanotechnologies inspire new possible solutions to major environmental issues nowadays. It has been reported that adsorption strategies using nanoparticles turned beneficial as hematite proved to be very efficient for the removal of arsenic in drinking water. However, the adsorption mechanism is not yet clear. In order to shed light on this subject, we attempt to study the interactions between arsenic species and α-Fe_2O_3 nanoparticles in aqueous medium. The iron oxide nanoparticles were prepared using a solvothermal method. Synthesized hematite nanoparticles were put in contact with As_2O_3 solutions at room temperature and at pH 4 and 7. The nanoparticles were characterized by FTIR, XRD, UV-vis, XRF and XPS. The results showed that synthesized nanoparticles had an average diameter of crystallite of 30 nm and from XRD pattern also was confirmed a rhombohedra hexagonal close-packed phase for the powders obtained (α-Fe_2O_3). From optical studies was evidenced that hematite nanoparticle obtained, have semiconductor properties due to band gap value, in this case 2.2 eV. The presence of arsenic on particles surface was confirmed, which is more remarkable when pH=7 condition is employed. On the other hand, after adsorption experiment, it was evident from FTIR and XPS that once arsenic species interact with the nanoparticles, they form mono and bi-dentate surface complexes. The developed methodology could be implemented in the water treatment industries, reducing the costs of the processes and making them more environmental friendly.

herlysvc.231289@gmail.com