The role of synthesis method on ZnO nanoparticles: implications for zinc dissolution and arsenite adsorption in water

Mokhtar Ali Amrani a,*, Asmita S. Gadha b, Nitin K. Labhasetwar b, Ahmed Sadeq Al-Fatesh c,*, Sajjad Haider c,*

a Faculty of Engineering and Information Technology, Taiz University, 6803 Taiz, Yemen, Tel. +967716186473; email: mokh_amrani@yahoo.com
b Energy and Resource Management Division, CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nehru Marg, Nagpur 440 020, India
c Department of Chemical Engineering, College of Engineering, King Saud University, P.O. Box 800, Riyadh 11421, Saudi Arabia, Tel. +966-11-467-6859; Fax: +966-11-467-8770; email: aalfatesh@ksu.edu.sa

Received 3 October 2017; Accepted 19 June 2018

ABSTRACT

In the recent past, intensive studies have been directed towards the use of zinc oxide nanoparticles (ZnO-NPs) for pollutant uptake and pathogens deactivation from water. However, the chemical behaviour of these suspended colloids in water and their solubility measurements is still not fully understood. Herein, a green synthesis approach was used to fabricate surface-modified ZnO-NPs using Dracaena cinnabari (Dragon’s blood) extract. A ZnO control sample for comparison was synthesized at similar conditions but without the extract. The obtained powder samples were characterized for structural, morphological and surface properties using various multidisciplinary tools. The environmental stability and adsorption behaviour of surface-modified ZnO-NPs (S1) and pristine ZnO (S2) were studied in aqueous solution at various conditions. S1 sample showed high adsorption capacity for Arsenite (As (III)) and least leaching of Zn ions into water as compared with S2. The results of Zn ions leaching into water (in case of S2) inferred that pristine ZnO sample (S2) was unstable in alkaline and acidic conditions, suggesting its unviability as an adsorbent in most conditions. However, the green synthesis approach for the synthesis of ZnO-NPs has proved a potential step forward towards the safe use of ZnO-NPs for water purification systems.

Keywords: Water purification; Dragon’s blood; Dissolution; Green synthesis; Leaching; Adsorption

* Corresponding author.