

PO1010

Plasma polymer coated silica particles: A new class of heavy metal adsorbentsBehnam Akhavan¹, Karyn Jarvis², Peter Majewski²¹The University of Sydney, Sydney, Australia ²University of South Australia, Adelaide, Australia

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More than 750 million people lack access to clean water, and every minute a child dies because of a water-related disease. Herein, we present the fabrication of highly negatively charged particles via an innovative plasma-assisted approach for the removal of heavy metal ions from water. Thiophene plasma polymerization has been used to deposit sulfur-rich films onto silica particles followed by the introduction of oxidized sulfur functionalities via water plasma treatments. The deposition and treatment processes were carried out using a radio frequency inductively coupled reactor fitted with a rotating chamber. Surface chemistry analyses were conducted by X-ray photoelectron spectroscopy (XPS) and time of flight secondary ion mass spectroscopy (ToF-SIMS). Electrokinetic measurements quantified the zeta potentials and isoelectric points (IEP) of modified particles, and indicated significant decreases of zeta potentials and IEP's upon plasma modification of particles. The effectiveness of developed surfaces in the adsorption of heavy metal ions was demonstrated through copper (Cu) and zinc (Zn) removal experiments. The removal of metal ions was examined through changing initial pH of solution, removal time, and mass of particles. Increasing the water plasma treatment time up to 20 minutes significantly increased the metal removal efficiency (MRE) of modified particles; whereas further increasing the plasma treatment time reduced the MRE due to the influence of an ablation mechanism. The developed particulate surfaces were capable of removing more than 96.7% of both Cu and Zn ions in 1 hour. The combination of plasma polymerization and oxidative plasma treatment has shown to be an effective method for the fabrication of new adsorbents for the removal of heavy metals.

Keywords

Plasma polymerization

Silica particles

Water purification

Heavy metals

Adsorption