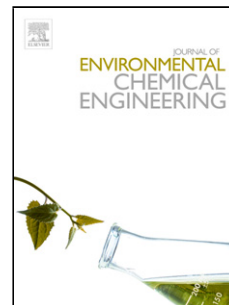


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Simultaneous adsorption of silver nanoparticles and silver ions on large pore mesoporous silica

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Abstract

Large pore mesoporous silica was synthesized using citric acid as template and modified with mercaptopropyl trimethoxysilane. The MP-Silica exhibited a surface area of $474 \text{ m}^2 \text{ g}^{-1}$ with an average pore diameter of 11 nm (pore diameter ranging from 2 to 30 nm). The material was used in the adsorption of silver ions, AgNPs and simultaneous adsorption of these silver species was also observed. The adsorption of silver ions occurred rapidly and followed a pseudo-second order kinetic model. The adsorption equilibrium of silver ions could be described with a Langmuir isotherm and the maximum adsorption capacity was found to be 114.9 mg g^{-1} . In the mixture of AgNPs and silver ions, the adsorption of AgNPs followed a pseudo-second order kinetic model and took place more slowly compared to silver ions due to their larger size. The MP-Silica exhibited a maximum adsorption capacity of $91.9 \text{ mg AgNPs g}^{-1}$ in the mixture. The adsorption of silver species on MP-Silica occurred through chemisorption *via* the coordination of these species with thiol groups on the surface. The removal of silver species from wastewater samples and consumer products by MP-Silica was demonstrated.

Keywords: large pore mesoporous silica; adsorption equilibrium; adsorption kinetics; silver nanoparticles; silver ions

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