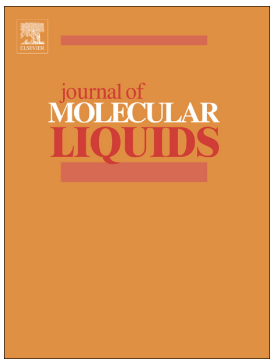

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Functionalization of nanosilica via guanidinium ionic liquid for the recovery of gold ions from aqueous solutions

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Abstract

A new adsorbent was prepared via modifying nanosilica with guanidinium ionic liquids for effectively adsorbing gold ions from aqueous solution. Fourier transform infrared spectrometer (FT-IR), thermogravimetric analysis (TGA) and X-ray photoelectron spectroscopy (XPS) were used to characterize the adsorbent. Batch experiments were applied to investigate the effects of initial pH, initial gold ions concentration, contact time and coexisting ions on the removal of gold ions from aqueous solutions. The adsorbent exhibits an excellent selectivity for gold ions in the presence of Pb(II), Mg(II), Ba(II) and Cu(II) ions. The removal rate of gold ions is higher than 97.06 % in the pH ranges from 2 to 5. The maximum uptake was 120.56 mg/g under pH 5. The adsorption kinetic was well described by the pseudo-second-order model. The adsorption isotherm followed Hill model very well. Therefore, the new adsorbent has a potential application in the field of separation of gold ions from aqueous solutions.

Key words: nanosilica, adsorbent, selective adsorption, gold ions

1. Introduction

Gold is widely used in various fields, including medicine, electronic, catalysts, jewelry, and so on [1,2]. Because gold has unique physical and chemical properties, for example, chemical stability, corrosion resistance and ductility [3,4]. The etching of gold is involved in the electrical industry. Aqua regia is commonly used to leach gold from the electronic waste [5,6]. The gold concentration is higher in the etching and leaching solution than that in natural ore. Therefore, there is necessary to recovery gold from secondary sources for efficient use of resources.

The conventional recovery methods include solvent extraction [7,8], electrolysis [9,10], displacement precipitation[11], ion-exchange[12,13] and adsorption[14,15]. Solvent extraction is hazardous for the environment because most of the organic solvents are toxic, flammable and volatile. Ion-exchange techniques are less selective. The adsorption is an emerging method for the recovery of gold from solution due to its low cost and high efficiency[16]. Nowadays all kinds of sorbents, such as amberlite XAD-2000 resin [17,18], carbon nanotubes[19], aminopropyl silica gel[20],chelating resins[21] and activated carbon [22, 23] have been developed for the