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Synthesis of bifunctional mesoporous silica spheres as potential adsorbent for ions in solution

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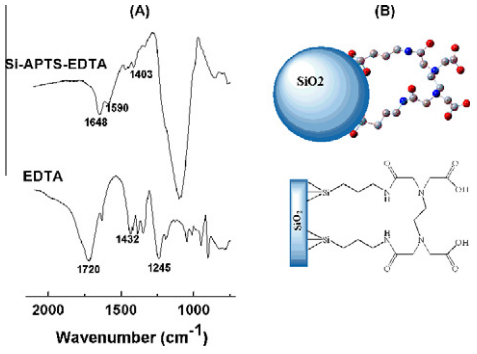
HIGHLIGHTS

- The immobilization of EDTA on Si–APTS composite was observed to occur in a stoichiometric relation of 2(APTS):1(EDTA).
- IR and NMR data suggest a cavity-like structure with four nitrogen atoms inside and two carboxylate groups outside.
- Adsorption assays for ions indicated a potential applicability of the Si–APTS–EDTA spheres as a bifunctional material.

GRAPHICAL ABSTRACT



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ABSTRACT

The immobilization of EDTA on Si–APTS composite was observed to occur in a stoichiometric relation of 2(APTS):1(EDTA) with a degree of functionalization of 0.56 mmol g^{-1}. Based on IR and NMR data it was suggested that the immobilization results in a cavity with four nitrogen atoms inside and two carboxylate groups outside. Surface area, total pore volume and average pore diameter, of the Si–APTS–EDTA spheres were determined, respectively, as 177.6 m^2 g^{-1}, 0.35 cm^3 g^{-1} and 73.6 Å. Zeta potential (PZC = 5.0) and adsorption assays indicated a potential applicability of the Si–APTS–EDTA spheres as a bifunctional material since it was observed the adsorption of cations and anions.

1. Introduction

The presence of potentially toxic substances in natural reservoirs has very large repercussions in the economy and on public health. Therefore, the global concern on environmental issues, particularly those related to heavy metals and anions, has been raised over the last decades. A superficial search in the web of science database for "removal" AND "heavy metals" results in 7000 entries for the last five years. This information reflects the relevance and how this theme is still actual for the scientific community. In addition and not less important, it is the financial concern. According to the Environmental Protection Agency of the United States, the American Recovery and Reinvestment Act (ARRA) provided $7.2 billion for environmental programs in January 2012. These concerns have motivated research groups to look for efficient materials for the treatment of liquid effluents containing toxic substances. In this sense, several species have been widely used in SLPE (Solid–Liquid Phase Extraction) method [1–7]. Selectivity, efficiency and versatility are among the most sought properties in

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