



Cobalt and copper alginate spheres for hydrogen sulfide capture

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Abstract In this article it is reported the use of cobalt (CoAlg) and copper (CuAlg) alginate spheres for hydrogen sulfide capture. The hydrogen sulfide maximum capture capacity of the hybrid matrices are 12.8 and 3.5 mg/g for (CoAlg) and (CuAlg), respectively.

Keywords Alginate, Hydrogen sulfide, Adsorption, cobalt, copper

Introduction

Hydrogen sulfide is an important air and water pollutant, and large amounts of it are produced as a by-product of industry. Been soluble in water and organic solvents, H₂S actuates as a strong corrosive agent towards metals. Hence, there is a lot of interest in obtain chemical or physical routs and procedures able to capture, from air or water, this compound.

In this connection, new matrices have been prepared for H₂S capture/removal, such as dye modified clays [1] or polymer modified matrices [2].

In this article it is reported the use of cobalt and copper alginate spheres for hydrogen sulfide capture.

Experimental

The cobalt and copper alginate spheres were prepared by using a 2.5% sodium alginate solution. Such solution was, drop by drop, added to a 2.0 mol/L solution of CoCl₂ or Cu(NO₃)₂. The cobalt (CoAlg) and copper (CuAlg) alginate spheres were then filtered off and dried at room temperature prior do the adsorption studies.

The hydrogen sulfide (H₂S) employed to adsorption on the modified matrices were prepared by reacting FeS with concentrated HCl. The adsorption processes were preformed as follows: about 2.4 cm³ of the modified matrix was confined in a glass reactor thorough which a H₂S flux (10 cm³/min) was passed by 30 minutes. The total masses of employed modified matrices were measured in an analytical balance before and after exposure to H₂S. So, the total amount of adsorbed H₂S per gram of modified matrix was determined gravimetrically.

The X-ray diffraction patterns were obtained in a Rigaku diffractometer model Miniflex II, with a scan rate of 5°/min, applied voltage of 15kV and current 15 mA, using Cu K α radiation and a Ni filter.

The FTIR spectra were obtained in a PerkinElmer apparatus, model Spectrum 65 in KBr discs (4000 to 400cm⁻¹).

Results and Discussion

The obtained X-ray patterns shows that all samples, before and after H₂S adsorption are amorphous, or, in the best hypothesis, of very low crystallinity. As an illustrative example, the X-ray diffraction patterns for the sodium

spheres before and after ionic exchange with copper are shown in Figure 1. All samples (including those after H₂S exposure) exhibits similar patterns.

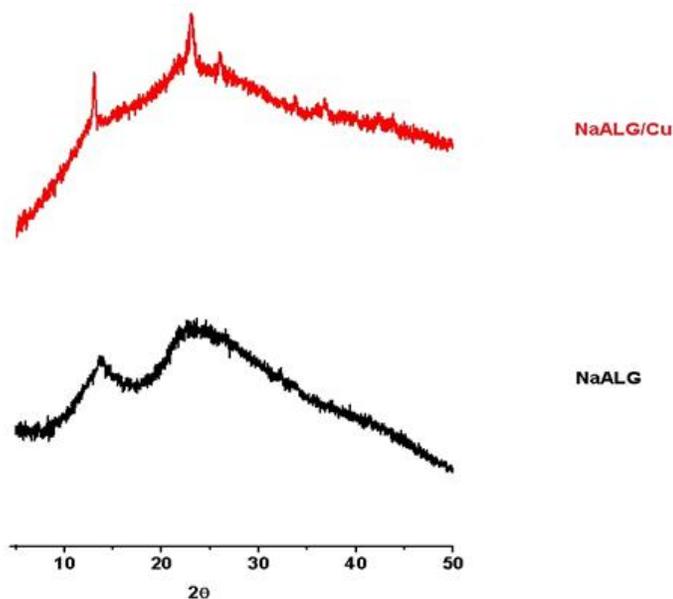


Figure 1: X-ray diffraction patterns for sodium alginate spheres before and after copper ionic exchange

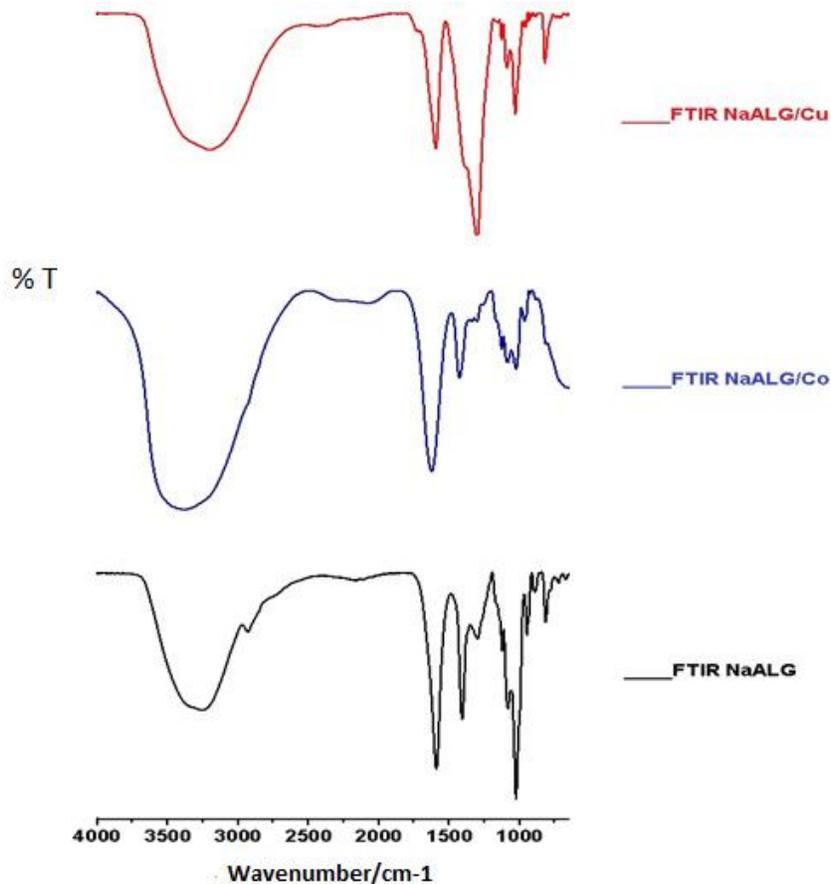


Figure 2: FTIR spectra for NaAg, CoAg and CuAg spheres



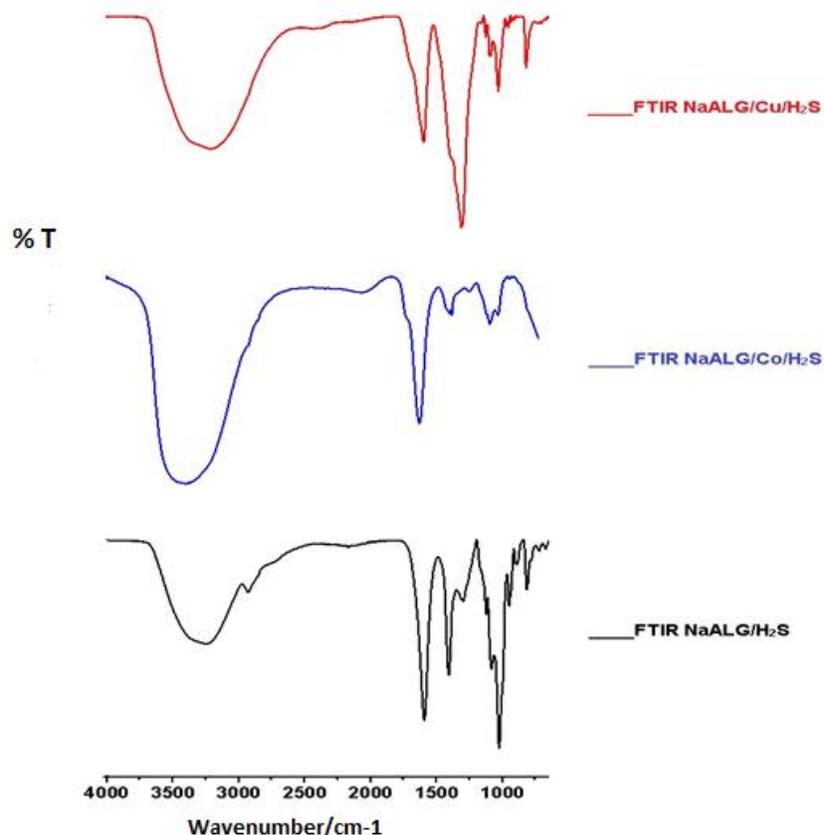


Figure 3: FTIR spectra for NaAg, CoAg and CuAg spheres after exposure to H₂S

The FTIR spectra for NaAg, CoAg and CuAg spheres in Figure 1. The FTIR spectra for NaAg, CoAg and CuAg spheres after exposure to H₂S are shown in Figure 2.

For the sodium alginate sample, the main bands are those at 3312, 2934, 1603/1415 and 1037 cm⁻¹, associated to OH, CH, COO and CO vibration modes, respectively.

As can be verified, the ion exchange process and the H₂S capture has not significant effect (any variation is the in the 4 cm⁻¹ range) on this infrared bands.

The hydrogen sulfide maximum capture capacity of the hybrid matrices are 12.8 and 3.5 mg/g for (CoAlg) and (CuAlg), respectively. The adsorption/removal capacity exhibited by the cobalt alginate matrix is well above those exhibited by Polymethylmethacrylate (PMMA) spheres covered with vanadyl phosphate (PMMA-VP), vanadium pentoxide (PMMA-VO) and rhodamine-B (PMMA-RB) [2]: 2.06, 9.54 and 3.33 mg/g for PMMA-VP, PMMA-VO and PMMA-RB, respectively.

The about four times higher H₂S removal capacity of the cobalt matrix in comparison with the copper one, can be attributed to the different coordination features of cobalt and copper, with cobalt generally forming hexa-coordinated complexes [3]. Hydrogen sulfide is a soft base, and both, Co(II) and Cu(II) are borderline acids [3]. However, as is well known, Cu(II) generally exhibits higher affinities towards nitrogen containing ligands.

References

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