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Evaluation of metal adsorption by an organo-functionalized silsesquioxane

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An important source of potentially toxic metals is the mining of stones and volcanic dust. In addition to this, humans also play a role in the release of toxic metal ions through activities such as dyeing, metal plating and battery manufacturing. Environmental pollution from cause by such has raised serious concerns due to their carcinogenic properties, indestructibility, and biological accumulation. The adsorption of them from industrial effluents is a significant environmental issue [1]. Hence, this study focused on developing of a chemical system capable of adsorbing metal ions present in wastewater. We synthesized a polyhedral oligomeric silsesquioxane (POSS) functionalized with the molecule bis(pyridin-2-ylmethyl)amine [2], which was then tested as adsorbing agent in a solution containing fifteen different metal ions. The ligand was characterized by infrared (FTIR), ^{1}H and ^{13}C nuclear magnetic resonance (NMR) spectroscopies. The POSS was characterized by FTIR, solid-state ^{13}C and ^{29}Si NMR (Figure 1), elemental analysis of carbon, hydrogen and nitrogen (CHN), and thermogravimetric analysis (TGA). The results showed that the compound was successfully obtained, showing a degree of functionalization of 1.50 mmol/g. The adsorption capacity of POSS was evaluated for cobalt, nickel, copper, zinc, lead, aluminum, manganese, vanadium, chromium, arsenic, beryllium, selenium, cadmium, barium and uranium(Figure 1). A multi-element solution containing 5 ppm of each element was exposed to 10 mg of POSS in a batch over 24 h period. The POSS exhibited a higher adsorption capacity for V (97%), Cu (95%) and Pb (68%). For other metal ions such as Co, Ni, Zn, Cd and U, the removal percentages ranged from 19% to 34%. Beryllium had 4% removal and the other elements were not adsorbed. The data obtained reveal that functionalized POSS may be interesting materials for selective metal ions adsorption.

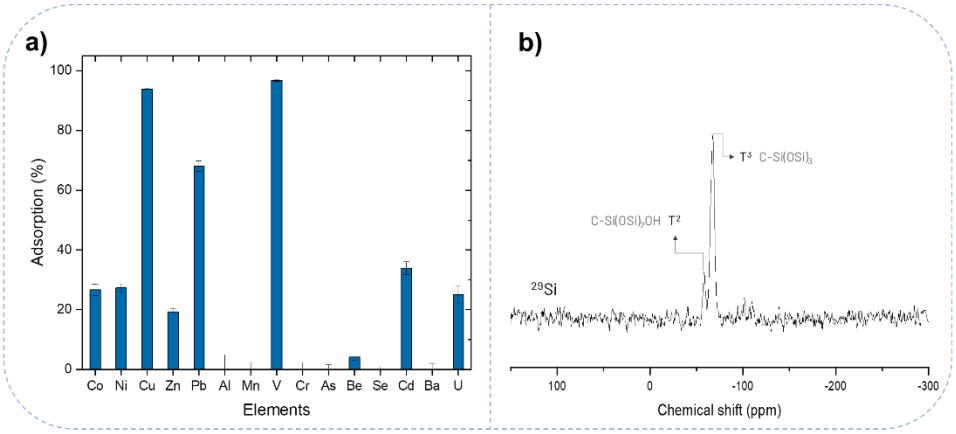

Figure 1. Percentage of adsorption of different metal ions (a) and ^{29}Si solid-state NMR (b) of the organo-functionalized POSS.

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References

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