Development of silica-based sorbents for combined treatment of natural and wastewater

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Access to clean water is a necessary condition for human life. Environmental pollution poses a serious threat to human health, natural resources and ecological systems. Climate change continues, associated with warming and irregular acidic atmospheric precipitation, which leads to increased dissolution of mineral components, and therefore, an increase in the amount of heavy metals. They are recognized as a dominant class of hazardous pollutants, due to their long retention time in soil and water and the problems they cause to the environment [1]. Adsorbent materials functionalized with chelating ligands such as aminopolycarboxylates [2-4], including EDTrA, were more effective than other adsorbents for efficient extraction of heavy metal ions [3-5]. In fact, the formation of multifunctional surface layers is an effective tool for more subtle control of the properties of silicas, in particular, to influence the sorption capacity.

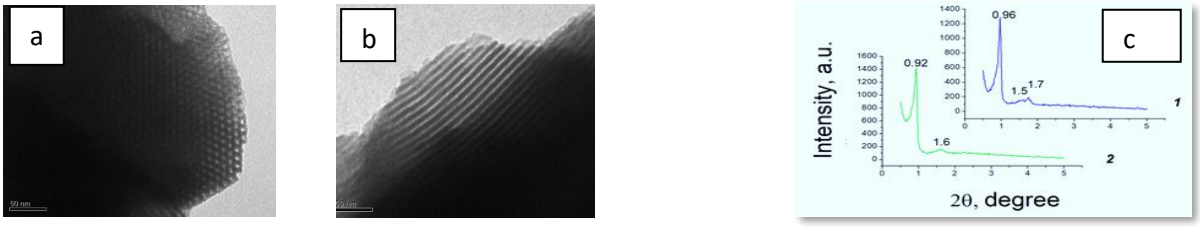

Fig. 1. TEM photo of SBA with derivatives of EDTrA (a) and NH_2(b), XRD (1 – SBA-NH_2, 2 - SBA-EDTrA)

The aim of this work was to develop approaches for the synthesis of stable mesoporous materials with broad functionality using ethylenediaminetriacetatic acid (EDTrA) and different amines (NH_2). Changing the coordination environment and steric accessibility of nitrogen atoms in functional groups and their concentration made it possible to determine the optimal conditions for the preparation of the adsorbent for the selective extraction of inorganic (Cr (III, VI), Mn (II, VII), Pb (II), Cd (II) and Cu (II)) and organic pollutants. The regeneration of the material with preservation of the main textural parameters (surface area, concentration of functional groups, etc.) was also studied in detail as a factor in reducing costs for adsorbents for water treatment. Finally, a comparative study of synthesized mesoporous silicas as adsorbents for the removal of heavy metals from waste and natural water was conducted, assessing the potential impact of macrocomponents of polluted water.

The OD is grateful for financial support from the Wenner-Gren Foundation

References

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