Nanocomposites and nanomaterials

Structural variety and adsorptive properties of mesoporous silicas with immobilized oligosaccharide groups

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Chemical modification of mesoporous silicas is of great scientific and practical interest since its permit to obtain materials with improved surface and structural properties (large surface areas and ordered mesostructures as well as binding to guest molecules) for potential applications in catalysis, adsorption, biosensing [1].

In this research, we report on the synthesis of mesoporous silicas with various quantities of immobilized oligosaccharide groups and different pore ordering degree. The co-condensation of tetraethyl orthosilicate and β-cyclodextrin(β-CD)-containing organosilane in the presence of cetyltrimethylammonium bromide template was employed. It was prepared several β-CD-organosilanes by modification of (3-aminopropyl)triethoxysilane (APTES) with -CD using N,N'-carbonyldiimidazole as linking agent, and the molar ratios for APTES and -CD were 1 : 1, 3 : 1, and 5 : 1, accordingly. Three MCM-41-type silicas (-CD-APTES-MCM-41, -CD-APTES$_3$-MCM-41, and -CD-APTES$_5$-MCM-41) were obtained. The quantitative chemical analysis exhibited 0.018, 0.072, and 0.095 mmol/g CD-group loading for these silicas, respectively. The IR spectroscopy and potentiometric titration were also performed to confirm the presence of functional groups in the silica matrix. N_2 sorptometry experiments exhibited the decrease of specific surface area and average pore diameter (calculated by NLDFT equilibrium model) of synthesized silicas with increasing of immobilized oligosaccharide groups. The effect of CD-group loadings on the forming of hexagonally arranged porous structure of synthesized silicas was evaluated by XRD analysis. Structural parameters (interplanar distance *d* and unit cell parameter *a*) were calculated from the diffraction peak attributed to the (100) reticular planes of ordered silicas. Adsorption experiments were carried out to study the effect of -CD incorporation in silica matrix on aromatic compounds uptakes from aqueous solutions.

1. *Asefa T., Tao Z.* Mesoporous silica and organosilica materials – review of their synthesis and organic functionalization // Can. J. Chem. –2012. –**90.** – P. 1015–1031.