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Hybrid Materials Obtained via Sol-Gel Way, by the Action of Teraethylorthosilicate with 1, 3, 4-Thiadiazole 2,5-Bifunctional Compounds

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Abstract : The objective of the present study has been to synthesize and to characterize silica hybrid materials using sol-gel technic and to investigate their properties. Silica materials were successfully fabricated using various bi-functional 1,3,4-thiadiazoles and tetraethoxysilane (TEOS) as co-precursors via a facile one-pot sol-gel pathway. TEOS was introduced at room temperature with 1,3,4-thiadiazole 2,5-difunctiunal adducts, in ethanol as solvent and using HCl acid as catalyst. The sol-gel process lead to the formation of monolithic, coloured and transparent gels. TEOS was used as a principal network forming agent. The incorporation of 1,3,4-thiadiazole molecules was realized by attachment of these later onto a silica matrix. This allowed covalent linkage between organic and inorganic phases and lead to the formation of Si-N and Si-S bonds. The prepared hybrid materials were characterized by Fourier transform infrared, NMR ^{29}Si and ^{13}C, scanning electron microscopy and nitrogen absorption-desorption measurements. The optic and magnetic properties of hybrids are studied respectively by ultra violet-visible spectroscopy and electron paramagnetic resonance. It was shown in this work, that heterocyclic moieties were successfully attached in the hybrid skeleton. The formation of the Si-network composed of cyclic units (Q3 structures) connected by oxygen bridges (Q4 structures) was proved by ^{29}Si NMR spectroscopy. The Brunauer-Elmet-Teller nitrogen adsorption-desorption method shows that all the prepared xerogels have isotherms type IV and are mesoporous solids. The specific surface area and pore volume of these materials are important. The obtained results show that all materials are paramagnetic semiconductors. The data obtained by Nuclear magnetic resonance ^{29}Si and Fourier transform infrared spectroscopy, show that Si-OH and Si-NH groups existing in silica hybrids can participate in adsorption interactions. The obtained materials containing reactive centers could exhibit adsorption properties of metal ions due to the presence of OH and NH functionality in the mesoporous frame work. Our design of a simple method to prepare hybrid materials may give interest of the development of mesoporous hybrid systems and their use within the domain of environment in the future.

Keywords : hybrid materials, sol-gel process, 1,3,4-thiadaizole, TEOS
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