A versatile imidazole-based surfactant for the preparation of hierarchically porous (alumino)silicates

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Crystalline (zeolites) and amorphous (mesoporous silicas) (alumino)silicates applied as molecular sieves, sorbents, supports, and heterogeneous catalysts are a substantial part of modern industrial processes.[1] Despite the similarity of preparation strategy via hydrothermal synthesis,[2,3] the nature of the organic structure directing agents (OSDA), responsible for the formation of micro- or mesoporous networks is different. The ordered mesoporous silicas require a type of molecules that are able to form micelles in water solution, e.g. cetyltrimethylammonium bromide,[4] whereas zeolite frameworks are formed in presence of smaller polar molecules such as tetrapropylammonium hydroxide.[5]

In this work, we have developed a novel strategy of obtaining several ordered mesoporous materials using the same OSDA molecule - 1-hexadecyl-2,3-dimethyl-1H-imidazol-3-ium bromide (C_{16}IMZ). High-surface-area (1200 m$^2$/g) amorphous mesoporous silicates were prepared in absence of aluminum, the addition of aluminum results however in highly crystalline hierarchical MOR zeolites (V_{mic} 0.08 cm$^3$/g) with a nanorod morphology. The influence of the aluminum concentration, synthesis time and temperature on the structure, morphology, porosity, and acidity of the samples was determined by a combination of elemental analysis, Ar physisorption, TEM, SEM, XRD, NMR and IR studies.

The obtained mesoporous amorphous silica materials can be used as high-surface-area model supports for heterogeneous catalysis[6] or as drug delivery vehicles.[7] The strong Brønsted acidic mordenite nanorods are found to be very efficient catalysts for different hydrocarbon conversion reactions such as alkane hydroisomerization and Friedel-Crafts alkylations with substantial yield benefits compared to conventional microporous MOR zeolite.

![Figure 1. SEM/TEM images of as-synthesized amorphous silicate (left) and MOR nanorods (right)](image)


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