Physico-Chemical nanomaterials science

Self-assembled diamides : structural studies and functional materials

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We have developed a series of bis-amides that self-assemble in non-polar solvent and form nanotubes with lengths of several micrometers and diameters of a few tens of nm with a narrow distribution.[1,2] We will present the thermal and spectroscopic properties of these self-assemblies, then we will discuss the determination of their shape and size by two techniques: electron microscopy on freeze fractured samples and small angle scattering techniques. We show that these nanotubes can be used as templates to form large mesopores in organic resins by a "molding" process:[3] the tubes are formed in a mixture of monomer/crosslinkers, which yields a thermoreversible gel. Photopolymerization of this gel yields a resin containing the nanotubes. When the nanotubes are leached out with a dissociating solvent, they leave cylindrical pores. The morphology and size corresponds closely to those of the templating tubes, as shown by TEM and porosimetry. Basic treatment of the mesoporous resin can be used to functionalize the pores and synthesize mesoporous catalysts.[3] The resulting materials were tested as catalysts for a model reaction and showed an activity similar the one of alkaline-substituted mesoporous silica. We will also discuss the possibility to functionalize the nanotubes under their self-assembled state in gels and to transform them into reactive aerogels.

1. *Simon F.-X., Nguyen T. T. T., Díaz N., Schmutz M., Demé B., Jestin J., Combet J., Mésini P. J.* Self-assembling properties of a series of homologous ester-diamides – from ribbons to nanotubes // Soft Matter-2013.**-9.**-P. 8483–8493.
2. *Diaz N., Simon F. X., Schmutz M., Rawiso M., Decher G., Jestin J., Mésini P. J.* Self-assembled diamide nanotubes in organic solvents // Angew. Chem., Int. Ed. Engl.-2005.**-44.**-P. 3260-3264.
3. *Nguyen T. T. T., Simon F. X., Khelfallah N. S., Schmutz M., Mésini, P. J.* Mesoporous polymeric catalysts synthesized from self-assembled organic nanotubes as templates // J. Mater. Chem.-2010.**-20.**-P. 3831-3833