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Characterization of ionic liquid films in mesoporous SBA-15 by small-angle X-ray scattering

The immobilization of molecular catalysts in confined geometries of mesoporous support materials has been shown to selectively control the catalytic performance. An additional increase in yield and selectivity of catalytic reactions are expected by combining the spatial confinement of the pores with that of a thin ionic liquid film at the pore surface. Small angle X-ray scattering (SAXS) can provide an important contribution to the structural characterization of such materials. To prove the efficiency of this method, mesoporous silica materials with cylindrical mesopores ordered in a two-dimensional hexagonal lattice and a defined pore radius of 3.1 nm were filled with imidazolium based ionic liquids and investigated with SAXS. Using comprehensive multi-scale scattering models [1], we found that the scattering data can be quantitively analysed considering the scattering contributions from the silica grain surfaces [2], as well as meso- and micropores by combining appropriate form [3] and structure factor [4] models. This enabled us to determine the key structural parameters of the mesoporous silica materials, such as the lattice parameter, the pore radius as well as the thickness and correlation length of the microporous corona. Finally, the growth of the ionic liquid film, induced as the porous materials became increasingly loaded with ionic liquids, could be monitored on the Angström scale by systematic SAXS measurements.

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