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Liquid Crystal Templating of Ordered Mesoporous Aluminosilicates with Tailorable Surface Acidity

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Ordered mesoporous silica prepared via direct liquid crystal templating (DLCT) is an attractive support material for heterogeneous catalysis [1,2] because its pore size can be tailored precisely and reproducibly.[3,4] To transform such frameworks from passive supports into active catalytic components, we expand the tunability to surface acidity by incorporating aluminium into the silica matrix, coupling lyotropic-liquid crystal self-assembly with precise control over material properties.[5]

Using concentrated P123-solutions, silica and aluminium precursors are co-condensed directly around the micelles of the intermediately formed lyotropic liquid crystal, yielding hexagonally ordered mesostructures. By removal of the surfactant via calcination, materials with narrow pore size distributions over a broad range of Si/Al ratios are obtained (Figure 1).

Compared to conventional preparation processes, the DLCT approach holds the benefit of preserving mesoscopic order even at high Al loadings, which we verify by small-angle X-ray scattering, nitrogen physisorption, and electron microscopy. ^{27}Al MAS NMR, pyridine FT-IR and complementary titrations show that the balance of Brønsted and Lewis acidity can be tuned via synthesis conditions. These results underline the great potential of the DLCT process in designing mesoporous materials with tailor-made geometric and electronic properties.

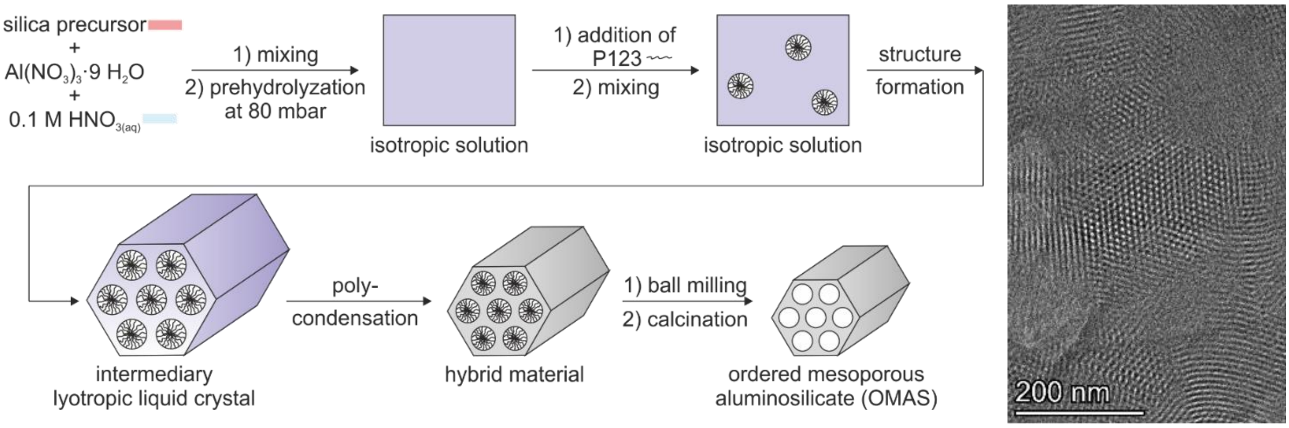

Figure 1. Synthesis of ordered mesoporous aluminosilicates via DLCT (left) and transmission electron micrograph of an ordered mesoporous aluminosilicate (right).

References

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