Functional Nanoporous Materials: Synthesis and Applications

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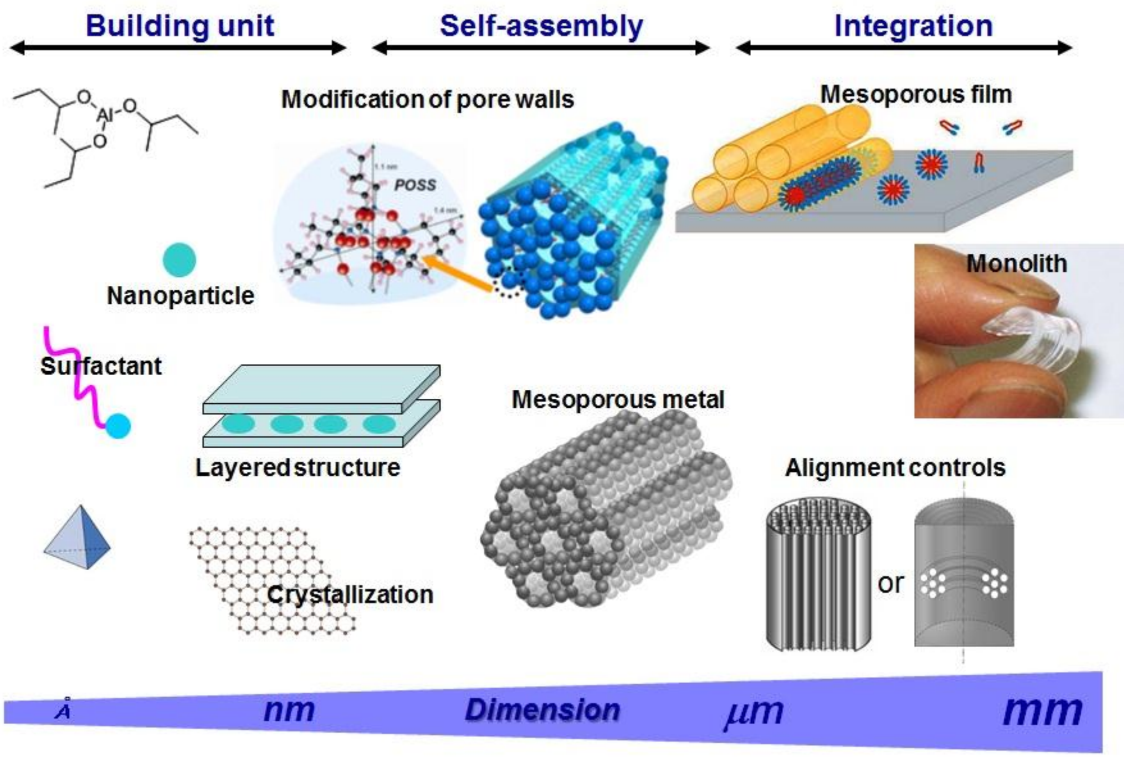
Currently, nanoporous materials prepared through the self-assembly of surfactants have attracted growing interests owing to their special properties, including uniform nanopores and a high specific surface area. Here we focus on fine controls of compositions, morphologies, nanochannel orientations which are important factors for design of porous materials with new functionalities. This presentation reports our recent progress toward advanced nanoporous materials. Nanoporous materials now include a variety of inorganic-based materials, for example, transition-metal oxides, carbons, inorganic-organic hybrid materials, polymers, and even metals. Nanoporous metals with metallic frameworks can be produced by using surfactant-based synthesis with electrochemical methods. Owing to their metallic frameworks, nanoporous metals with high electroconductivity and high surface areas hold promise for a wide range of potential applications, such as electronic devices, magnetic recording media, and metal catalysts. Fabrication of nanoporous materials with controllable morphologies is also one of the main subjects in this rapidly developing research field. Nanoporous materials in the form of films, spheres, fibers, and tubes have been obtained by various synthetic processes such as evaporation-mediated direct templating (EDIT), spray-dried techniques, and collaboration with hard-templates such as porous anodic alumina and polymer membranes. Furthermore, we have developed several approaches for orientation controls of 1D nanochannels. The macroscopic-scale controls of nanochannels are important for innovative applications such as molecular-scale devices and electrodes with enhanced diffusions of guest species.

References

[1] Y. Yamauchi et al., JACS, 135, 18040 (2013); JACS, 135, 16762 (2013); JACS, 135, 586 (2013); JACS, 135, 384 (2013); Angew. Chem. Int. Ed., Accepted (DOI: 10.1002/anie.201307126); Angew. Chem. Int. Ed., 52, 8050 (2013); Angew. Chem. Int. Ed., 52, 1235 (2013); JACS, 134, 10819 (2012); JACS, 134, 2864 (2012); JACS, 134, 2864 (2012); Angew. Chem. Int. Ed., 51, 984 (2012); JACS, 14526 (2011); JACS, 133, 9674 (2011); JACS, 133, 8102 (2011); Angew. Chem. Int. Ed., 50, 7410 (2011).

Figures



Building unit
Self-assembly
Integration
Modification of pore walls
POSS
Mesoporous film
Nanoparticle
Monolith
Surfactant
Layered structure
Mesoporous metal
Alignment controls
or
Crystallization
Å
nm
Dimension
μm
mm