Special Feature: Recent Research Developments on Periodic Mesoporous Organosilicas

Overview

Shinji Inagaki
Senior Fellow

Periodic mesoporous organosilica (PMO) is a functional porous material that was developed by Toyota Central R&D Labs., Inc. in 1999. PMOs, which are synthesized from organosilane precursors using surfactant as a structure-directing agent, have a highly ordered mesoporous structure and organic functionality in their framework. As a variety of organic groups can be incorporated into the framework, PMOs can be produced for a wide range of utilities such as for strong emission, light harvesting, charge transport and binding metals. Thus far, PMOs have been used in color-tunable emissive films, photocatalysis, photovoltaic devices, and solid supports for metal complex catalysis. This special feature presents recent advancements in PMO research.

The first article describes the molecular design of organosilane precursors for the formation of highly emissive PMOs and hydrogen-bonded PMOs, and the construction of photoinduced charge transfer systems on multifunctionalized PMOs. In the second article, the synthesis of a novel PMO containing 2,2'-bipyridine ligands in the framework (BPy-PMO) and applications to a solid support for heterogeneous metal complex catalysis are reported. The third article focuses on excited-state dynamics, such as excimer formation and energy migration, for the organic groups in PMO frameworks, as studied by time-resolved fluorescence and absorption spectroscopies. The fourth article reports computational studies on excimer formation of cyclophane derivatives as a model of the organic groups in a PMO framework, and the electron transfer between two different metal complexes (a photosensitizer and a catalyst) formed on the pore surface of BPy-PMO.