【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Chemistry)

Title of Project： Chemistry of Hierarchical Coordination Space

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Research Area： Coordination chemistry
Keyword： Porous crystal, Rational synthesis, Storage-Separation-Conversion

【Purpose and Background of the Research】

Porous material is used as a thing indispensable to a life of human beings over 3500 from ancient Egypt (activated carbon) to the present age (zeolite etc.). If novel materials are developed with porous functions (storage, separation, transformation, etc.) superior to conventional materials such as zeoltite and activated carbon, they bring innovative changes to the life of humankind. To realize the innovation, it is necessary to open up new science dealing with the synthesis, structures, and behaviors in space ranging from microscopic to macrosopic through mesoscopic scales.

We have developed new porous materials called as porous coordination polymers (PCPs) and led the world in this field. Among those materials, porous crystals with flexible nature have been developed, but they are also crystalline and can change their porous structures reversibly while retaining high regularity. To ultimately deepen and advance such soft porous functions, progress in the chemistry, which enables us to spatiotemporally control the molecular and ion recognition events, is necessary. In this research project, we focus on structural and temporal hierarchy in PCPs and consider the space in PCPs as "hierarchical coordination space", and aim to develop new scientific fields through the finding of new phenomena and specific principle in hierarchical coordination space.

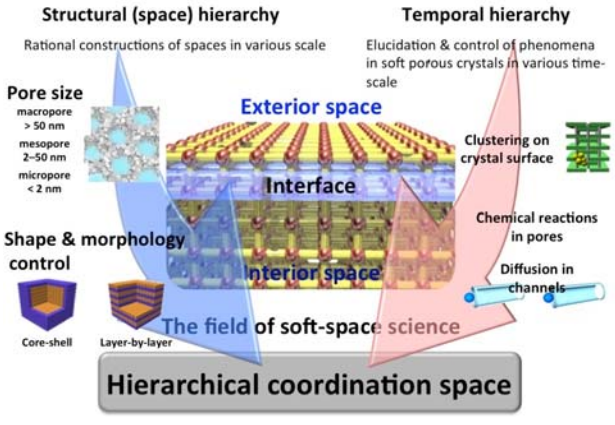

Figure 1 Hierarchical coordination space

【Research Methods】

Plan A: Ultra-precision separation and on-demand storage

Extreamly difficult targets still remain in separation. For example, our targets are (a) gas separation at ambient conditions, (b) isotope separation, and (c) selective separation of trace gases.

Plan B: Chemical conversions

We develop new porous systems for chemical conversions. Our target is the development of new science and technolgy for conversions by (a) control of isomerization phenomena and (b) dynamic metal clusters installed in PCPs.

Plan C: Anisotropic transport

We aim to cultivate new science to control anisotropic transport phenomena in meso and macro scales by immobilizing PCP crystals on lipid bilayer membrane and cell membrain, or by integration of PCP crystals to create membrane materials.

【Expected Research Achievements and Scientific Significance】

"Technology and science for on-demand control of small molecule" is eagerly awaited from the social demands for sustainable society. In particular, science and technology, which realize conversion of gas molecules in air or exhaust gases into valuable chemicals, have the potential to fundamentally solve the energy problem and natural resource issues.

【Publications Relevant to the Project】

・Y. Sakata *et al.* ***Science***, 339, 193–196 (2013).
・H. Sato *et al.* ***Nat. Mater.*** 9, 661–666 (2010).

【Term of Project】 FY2013-2017

【Budget Allocation】 440, 600 Thousand Yen

【Homepage Address and Other Contact Information】

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