【Grant-in-Aid for Scientific Research (S)】

Broad Section E

Title of Project : Chemistry of Adaptable Space

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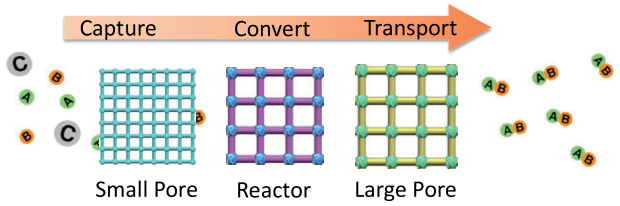
Research Project Number : 18H05262 Researcher Number : 20140303
Keyword : Porous Coordination Polymer, Dynamic Function, Interface, Mass Transportation

【Purpose and Background of the Research】

Living organisms adapt themselves to various environmental changes. From chemistry standpoint, this spontaneous adaptation function is realized by the establishment of a "flow" that governs nano-level multiple functions such as transmitting molecular signals and transferring ions between inside and outside the cell membrane. In this research, we design a basic operation of living organisms such as reception, detection, transfer, conversion, etc. into porous materials by encoding those functional essences in dynamic nanospaces, to establish a new scientific paradigm of porous materials that respond to various environmental changes and signals.

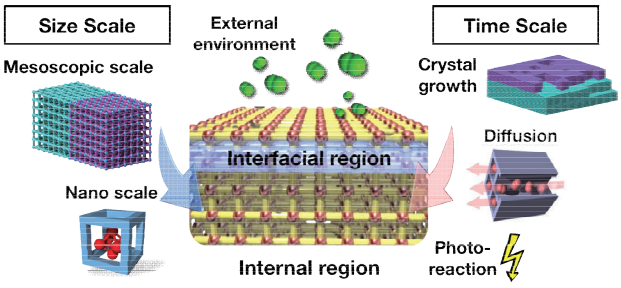
Specifically, Porous Coordination Polymers (PCP, Metal–Organic Framework: MOF) is mainly used as a nanospace platform for developing targeted functions. Chemistry for fusing different PCP crystals will be studied and developed to establish fundamental technologies for creating flows that amplify and propagate molecular signals. This represents the system and theory in "Chemistry of Adaptable Space" that we propose.



【Research Methods】

An important issue in creating the adaptive space is the development of an organic fusion method of PCP crystals. Designs of crystallite size, electric charge and molecular motions in nanopores as well as understanding interface structures of PCP crystals are essential foundation of this research.

For the fusion of PCP crystals and nanopore domains, we apply epitaxial growth method[1] and synthesis of molten PCP[2] that we have developed. Synthesis of asymmetric PCP single crystals having different pore diameters and static potentials, etc., will be targeted to realize the flow that propagates and transmits stimuli and signals.



【Expected Research Achievements and Scientific Significance】

Following outcomes are anticipated: (1) Development of new materials that separate, capture and convert in response to concentrations of component gas species such as CO_2, CO, CH_4, O_2, etc. in exhaust gas, flue gas, and biogas, etc. (2) Applications to such as membranes that regulate ionic species such as Li^+, Na^+, Ca^{2+}, and NH^{4+}, etc. and spontaneously control their conductivity in response to external environment. This research will lead to the creation of materials with synergistic molecule/information conversion function which cannot be obtained by individual function of a single substance.

【Publications Relevant to the Project】

1."Sequential Functionalization of Porous Coordination Polymer Crystals." Hirai, K.; Furukawa, S.; Kondo, M.; Uehara, H.; Sakata, O.; Kitagawa, S. *Angew. Chem. Int. Edit.* **2011**, *50*, 8057–8061.

2."Reversible Solid-to-Liquid Phase Transition of Coordination Polymer Crystals" Umeyama, D.; Horike, S.; Inukai, M.; Itakura, T.; Kitagawa, S. *J. Am. Chem. Soc.*, **2015**, *137*, 864–870.

【Term of Project】 FY2018-2022

【Budget Allocation】 149,500 Thousand Yen

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