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Welcome to Small Spaces
-Soft Crystalline Porous Coordination Polymers -

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Abstract:

With the Industrial Revolution in the 19th century, humans began to create technologies that consumed huge amounts of energy. Initially, people used coal (solid) as an energy resource, but the 20th century ushered in the age of petroleum (liquid). In the 21th century, where the depletion of petroleum has become a concern, gases (e.g., natural gas and biogas and even air) should play important roles. Hence, the trend has been shifting from solid to liquid to gas. The future should realize the "age of gas", which will eventually utilize ubiquitous gases such as air. In this context, porous materials with nanosized spaces will significantly contribute to the science and technology that handles gases *ad arbitrium*. Materials with nanosized spaces, which are well known as porous materials, are abundant in everyday modern life; they are used for gas storage, separation, and catalysis. One of the earliest historical records of a porous material is noted on papyrus; the record indicates activated carbon was used in medical treatments in ancient Egypt. About 3,000 years later in 1753, a new porous material, zeolite, was discovered in natural ores. Zeolite was successfully synthesized in the first half of the 20th century, and has contributed remarkably to large-scale processes such as in the petroleum industry. The discovery of novel materials with functions superior to activated carbon and zeolite would drastically change human life. However, the synthesis of new porous materials remained stagnant until the early 1990s, when interest in the field first became widespread. Based on the revolutionary concept of bottom-up synthesis, we are now able to successfully develop novel porous materials including everything from serendipitous findings to tailor-made synthesis. These are called "porous coordination polymers" (PCPs) or "metal-organic frameworks" (MOFs), which are comprised of organic and inorganic materials. MOFs have great potential in applications for our immediate surroundings as well as a wide variety of fields, such as the global environment, natural resources, development of outer space, life sciences, and energy, demonstrating their extremely high value both for science and for industry [1,2].

References:

[1] S. Kitagawa, *Acc. Chem. Res.*, 2017, 50, 514–516. *Commentary*
[2] S. Kitagawa, *Angew.Chem.Int.Ed.*,2015,54,10686-10687. *Editorial*

Susumu Kitagawa was born in 1951. He received his Ph.D. at Kyoto University and is now Distinguished Professor of Kyoto University, and Director of Institute for Integrated Cell-Material Sciences (WPI-iCeMS) at Kyoto University. His main research field is materials science based on coordination chemistry: synthesis of porous coordination polymers (PCPs) and metal-organic frameworks (MOFs).

He received the Japan Society of Coordination Chemistry Award (2007), Humboldt Research Award (2008), Thomson Reuters Citation Laureate (Chemistry) (2010), the RSC de Gennes Prize (2013), the 58th Fujihara Award (2017), Clarivate Analytics Highly Cited Researcher (2017), and Chemistry for the Future Solvay Prize (2017).