Design and control of the gas diffusion process in a nanoporous soft crystal

Dr. Gu Cheng (顾成), Dr. Nobuhiko Hosono and Prof. Susumu Kitagawa at Kyoto University (Dr. Gu Cheng is the first author of this work, and he is currently a full professor in the State Key Laboratory of Luminescent Materials and Devices, South China University of Technology) reported recently on the design and control of the gas diffusion process in a nanoporous soft crystal, which was published in *Science* (2019, 363: 387—391).

Design of the gas-diffusion process in a porous material is challenging because a contracted pore aperture is a prerequisite, while the channel traffic of guest molecules is regulated by the flexible and dynamic motions of nanochannels. The research team presented the rational design of a diffusion-regulatory system in a porous coordination polymer (PCP), in which flip—flop molecular motions within the framework structure provide kinetic gate functions enabling efficient gas separation and storage. The PCP shows significant temperature-responsive adsorption in which the adsorbate molecules are differentiated by each gate-admission temperature, facilitating kinetics-based gas separations of oxygen/argon and ethylene/ethane with high selectivities of ~350 and ~75, respectively. Additionally, they demonstrated the long-lasting physical encapsulation of ethylene at ambient conditions, owing to strongly impeded diffusion in distinctive nanochannels. They could provide a platform for PCPs possessing a mechanism of diffusion control and confinement of guest molecules, which results from cooperation of the global dynamics of a whole crystal and local dynamics of organic constituents. This rationale can provide a blueprint for a wide range of gas adsorbents for efficient separation and storage.

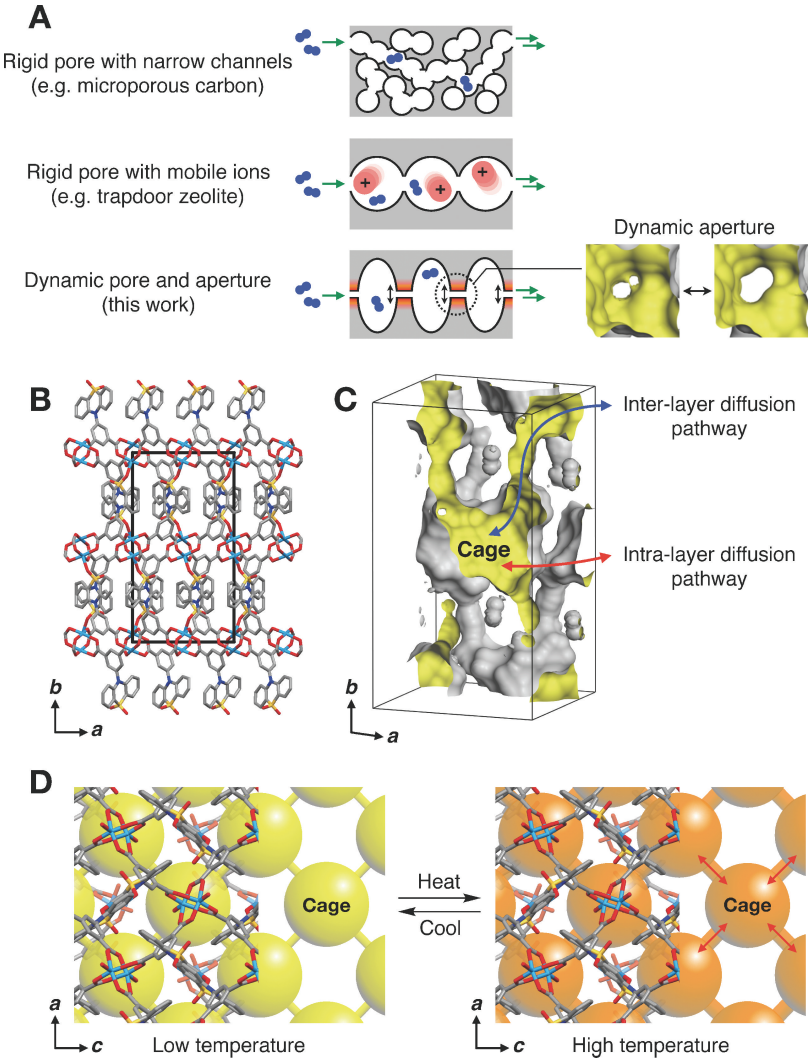

Figure Depicting the structure of a diffusion-regulatory PCP.