Real-time analysis of MOF adsorption behavior

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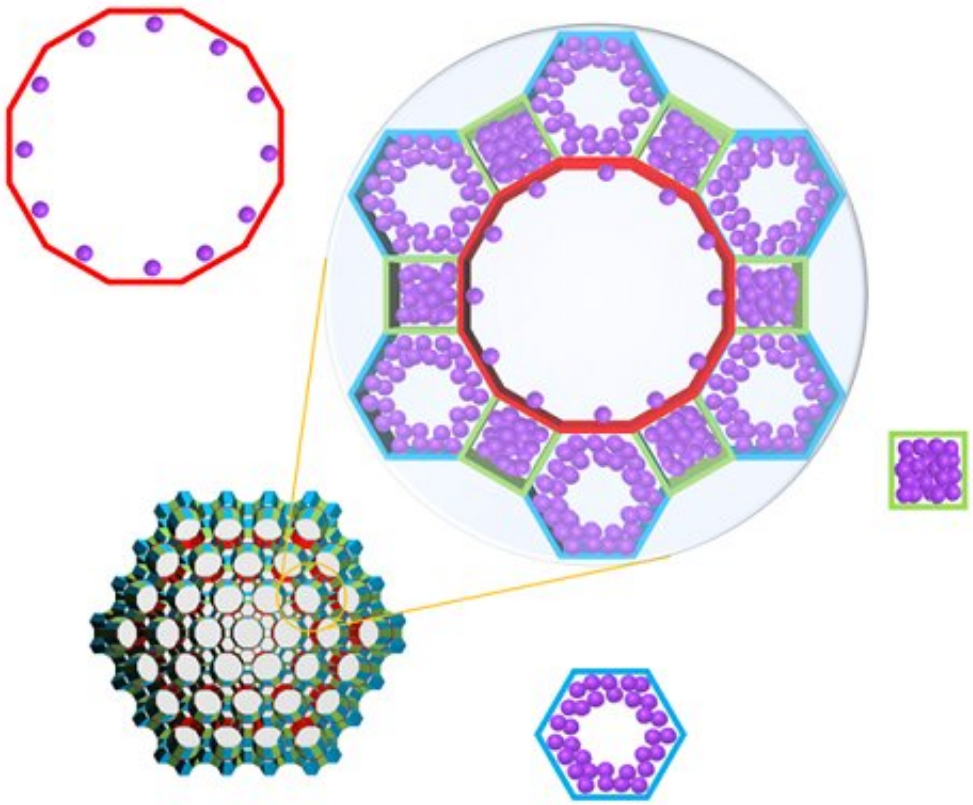

Schematic illustration of molecules adsorbed on metal organic frameworks with different pores of various structures, where the In-situ X-ray crystallography has been developed to classify each pore structure and analyze the position of the molecule to determine the amount of molecules adsorbed to each pore. Credit: KAIST

Researchers have developed a technology to analyze the adsorption behavior of molecules in each individual pore of a metal organic framework (MOF). This system has large specific surface areas, allowing for the real-time observation of the adsorption process of an MOF, a new material effective for sorting carbon dioxide, hydrogen, and methane.

Accurate measurements and assessments of gas adsorption isotherms are important for characterizing porous materials and developing their applications. The existing technology is only able to measure the amount of gas molecules adsorbed to the material, without directly observing the adsorption behavior.

The research team led by Professor Jeung Ku Kang from the Graduate School of Energy, Environment, Water and Sustainability (EEWS) prescribed a real time gas adsorption crystallography system by integrating an existing X-ray diffraction (XRD) measurement device that can provide structural information and a gas adsorption measurement device.

Specifically, the system allowed the observation of a mesoporous MOF that has multiple pores rather than a single pore structure. The research team categorized the adsorption behaviors of MOF molecules by pore type, followed by observations and measurements, resulting in the identification of a stepwise adsorption process that was previously not possible to analyze.

Further, the team systematically and quantitatively analyzed how the pore structure and the type of adsorption molecule affect the adsorption behavior to suggest what type of MOF structure is appropriate as a storage material for each type of adsorption behavior.

Professor Kang said, "We quantitatively analyzed each pore molecule in

real time to identify the effects of chemical and structural properties of pores on adsorption behavior." He continued, "By understanding the real-time adsorption behavior of molecules at the level of the pores that form the material, rather than the whole material, we will be able to apply this technology to develop a new high-capacity storage material."

More information: Hae Sung Cho et al, Isotherms of individual pores by gas adsorption crystallography, *Nature Chemistry* (2019). DOI: 10.1038/s41557-019-0257-2

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