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Effect of MOF mechanochemical grinding on stability, grain size, and adsorption properties

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Metal-organic frameworks (MOFs) are organic-inorganic hybrid crystalline porous materials that consist of a regular array or cluster of metal ions surrounded by organic molecules (linkers). The metal ions form nodes that bind the arms of the linkers together to form a repeating, cage-like structure. Due to this hollow structure, MOFs have an extraordinarily large internal surface area and find various applications in the field of gas adsorption/separation, heterogeneous catalysis, drug delivery, sensor technology, and many others.

This study deals with the effect of mechanochemical milling of two known MOF materials, HKUST-1 and MOF-76, on their stability, particle size, and adsorption properties. Both compounds are composed of the same linker, benzene-1,3,5-tricarboxylate (BTC), but differ in the type of central atom, Cu(II) for HKUST-1 and Gd(III) for MOF-76. The materials were ground through a planetary mill at different speeds, times and balls of different diameters and number of pieces. The structure and stability of the materials were studied after the milling process using infrared spectroscopy, thermal analysis, and powder X-ray diffraction. The change in particle size of ground MOF materials and their textural properties were also investigated. The surface area (S_{BET}) of samples was calculated based on the nitrogen adsorption measurements, and the maximum storage capacity of CO_2 at 0 °C and 1 atm was also determined. The effect of MOFs′ milling on stability, particle size, textural properties, and impact on CO_2 storage will be presented in detail at the conference.

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