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Insight into thin film SURMOFs

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The development of MOF-based technologies has been a focus point of research over the last 20 years resulting in ca. 70,000 published structures studied for a wide range of applications including gas storage and separation, drug delivery, chemical sensing, among others. Their research continues to be fueled by the continuous improvement of their thermal and mechanical features powering a bright future ahead.

The synthesis of these materials has been one of the most investigated areas. When referring to the formation of homogeneous MOF thin films, the liquid phase epitaxial (LPE) layer-by-layer (LBL) formation has proven the acquisition of highly crystalline and oriented surface-mounted metal-organic frameworks (SURMOFs) suitable for integration as functional materials in multiple devices. In previous studies, ZIF-8 SURMOF synthesis via dipping at room temperature was systematically studied for alkane/alkene gas separation. Permeances and separation factors obtained agreed with other published synthesis techniques, but a great window of opportunity towards commercial feasibility still exists. Currently, this systematic approach is now being complemented with the incorporation of nanoparticles (e.g., Au, Pt) in various SURMOF systems to determine their potential in the field of catalysis of gaseous systems.

Additionally, a comprehensive understanding of the properties and transport mechanisms of these SURMOF films is required in order to further enhance their performance. In previous works, the Maxwell-Stefan surface diffusion model was employed to gather a general understanding of the ZIF-8 SURMOF and other porous systems. To deepen our theoretical knowledge of these systems, various SURMOF films are being further characterized, including the acquisition of proper adsorption data at higher temperatures and pressures, surface diffusivities, and the consideration of micro-defects; this data is of high importance for further simulation studies. By doing so, the successful design, development, and application of novel SURMOF materials might be facilitated.