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Synthesis of Conductive Metal-Organic Framework Thin Films

Developing conducting metal–organic frameworks (MOFs) provides an avenue for creating high surface area conductors with potential applications ranging from electrocatalysts and chemiresistive sensors to supercapacitors. Highly ordered and infinite charge transport pathways could be realized in conducting MOF platforms to yield high conductivity. However, it is challenging to engineer electrical conductivity in MOFs because these materials generally have flat bands determined by highly localized organic states and weak hybridization with the inorganic units. Based on using intermolecular π-stacking interactions as topology defining factors of MOFs, strategies for synthesizing and utilizing the conductive and microporous MOFs will be discussed. In addition, the synthesis of a conductive two-dimensional MOF thin film by single-step all-vapor phase chemical vapor deposition will be presented. The large-area thin film of $Cu_3(C_6O_6)_2$ synthesized in this study has high crystallinity and an edge-on-orientation. Using e-beam lithography, microdevices based on $Cu_3(C_6O_6)_2$ thin film were fabricated, which showed an electrical conductivity of 92.95 S/cm. The synthesis of conductive MOF thin films through all vapor-phase CVD could provide insights into the physical properties of these materials and pave the way for their practical applications.

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