Electrically Conductive Metal-Organic Frameworks

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The development of 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/ion transport pathways could be realized in conducting MOF platforms to yield high conductivity. However, it is difficult 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 factor of MOFs,[1] strategies for synthesizing and utilizing the conductive and microporous MOFs will be discussed. In addition, four isostructural materials of general formula M_2(TTFTB) (M = Mn, Co, Zn, and Cd; $TTFTB^{4-}$ = tetrathiafulvalene tetrabenzoate) were synthesized and their single crystal conductivities were studied. M_2(TTFTB) exhibit a striking correlation between their single-crystal conductivities and the shortest S···S interaction defined by neighboring TTF cores, which inversely correlates with the ionic radius of the metal ions.[2] These results provide a systematic blueprint for designing new electrically conductive MOFs based on the through-space charge transport formalism.

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