

Multifunctional metal-organic frameworks

Opportunity

We use metal-organic frameworks to create multifunctional materials that couple magnetic, electric, and structural properties. In these insulating materials, voltage rather than current couples to magnetism and no heat is dissipated.

The designability of the underlying meso-scale structure of metal-organic frameworks allows us to target desired functionalities.

Meso Challenge

Metal-organic frameworks provide multifunctionality by design. They are large porous organic materials with meso-scale molecular units. Electrically polar guest molecules within the pores can couple with magnetic host structures.

Approach

An intense focus in the chemistry community on metal-organic frameworks for gas sensing, storage and catalysis creates a wide knowledge base – we leverage it for our purposes, creating coupled magnetic and electric functionality. We greatly broaden the limited number of known magneto-electric materials and add designability and new functionalities.

Impact

Magnetolectric coupling and multiferroic behavior are an intense area of research for new sensors, novel and smart circuits, non-heat-dissipating spintronics, energy harvesting, energy storage, high-frequency and high-power solid state circuits, computer memories, among others.

References: O. M. Yaghi et al, Nature 423, 705 (2003); R. Ramesh, Nature 461, 1218 (2009)

