"Developing Functional Porous Frameworks: From Reticular Chemistry to Energy and Environmental Applications"

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Metal–Organic Frameworks (MOFs) represent a unique class of porous crystalline materials, being at the forefront of materials' chemistry the last decade. Constructed from meticulously chosen inorganic building blocks (namely, metal ions or clusters) connected through appropriately designed polytopic organic linkers.[1-3] Their modular nature, high surface area, and structural tunability have made them highly attractive for a plethora of applications, particularly in the fields of energy and environmental science — including gas storage and separation, catalysis, purification, sensing, storing and controlled release of volatile organic compounds.[2-4]

Central to the design of MOFs is Reticular Chemistry, an approach that enables the deliberate construction of extended frameworks through the predictable combination of molecular building units. The geometry of the organic linkers and the coordination environment of the metal nodes (Secondary Building Units, SBUs) critically determine the resulting topology, pore size, and overall functionality of the material.[1-2] Strategic selection and design of these building blocks allow for the synthesis of materials with tailored physicochemical properties targeted to specific applications that are expected to present enhanced properties and overcome existing limitations of conventional porous materials [3].

Through this presentation I would like to highlight selected examples illustrating the guided synthesis of MOFs using symmetric building units, emphasizing the relationship between topology and function [2-4]. In addition, we will explore examples that extend beyond classical Reticular Chemistry design principles. For example, frameworks based on asymmetric or non-standard linkers which exhibit unexpected topologies and unprecedented properties [5-7]. Lastly, we will also discuss the opportunities that the utilization of targeted networks can offer to the development of hybrid materials with enhanced properties. Various methodologies such as post synthetic modification or in situ decoration towards the enhancement of the initial properties of the pristine materials will be presented and discussed. Overall, we wish to showcase the continued evolution of MOF chemistry and its capacity to meet emerging technological challenges through careful materials' design.

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