

2021 International Solvay Chair in Chemistry



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4 ONLINE LECTURES VIA ZOOM

TUESDAY 9 NOVEMBER 2021 AT 4:00 PM

The Discovery of Covalent Organic Frameworks

The synthesis of covalently-linked organic extended structures has been a long-standing objective. The fundamental problem is that attempts to link organic molecular building blocks into extended structures often led to intractable amorphous solids and ill-defined materials, thus impeding development of this field. This changed when the reaction and crystallization conditions for making covalent organic frameworks (COFs) were worked out and reported in 2005 for 2D COFs and 2007 for 3D COFs. This advance extended the field of organic chemistry beyond discrete molecules (0D) and polymers (1D) to infinite layered (2D) and network (3D) extended structures. The discovery of reactions and crystallization conditions for making COFs using reversible as well as what is traditionally considered irreversible linkages (e.g. dioxin, olefin) will be outlined. The recent developments in (1) making large single crystals of COFs, (2) the first molecular weavings, and (3) greatly expanding structural complexity of COFs through building high valency nodes will be presented.

Zoom link: <https://us06web.zoom.us/j/83202662117?pwd=UUpGK2hMVzd6UXMzSElxOXdrOWw4Zz09>

TUESDAY 16 NOVEMBER 2021 AT 4:00 PM

Molecular Weaving

The ability to combine the strong bond approach of reticular chemistry with the mechanical bond results in unprecedented class of molecularly woven structures. This presentation will outline the strategies for carrying out molecular weaving using covalent organic framework building blocks. The result is a vast chemical space in which robustness and porosity are combined with flexibility to yield materials of exceptional resiliency and mechanical properties. The reaction chemistry and crystallization methodologies for producing woven structures in which threads are interlaced, and rings and polyhedra are interlocked will be discussed. The inclusion chemistry and evolution of dynamics in these systems will also be presented.

Zoom link: <https://us06web.zoom.us/j/85855230311?pwd=UjA5Z1R4NDQ3WUdOMVJHd0NiM2FBdz09>



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TUESDAY 23 NOVEMBER 2021 AT 4:00 PM

Reticular Chemistry: System of Sequences in Multivariate Metal-Organic Frameworks

Linking of molecular building blocks by strong bonds into crystalline extended structures (reticular chemistry) has resulted in metal-organic frameworks and made available precisely designed infinite 2D and 3D materials. Reticular chemistry has been focused on making simple structures in which a few kinds of component are linked to make crystals such as metal-organic frameworks MOFs. While this chemistry has grown into a large field, a more extensive area with fascinating directions is emerging through the introduction of multiplicity and variation into the components of these frameworks. When the framework's backbone is composed of more than two kinds of building unit, the resulting backbone multiplicity is regular repeats of those units. However, when variations involve multiple functionalization of the organic linkers or multiple metalation of metal-containing building units, it results in an aperiodic spatial arrangement of these variations, without altering the regularity of the MOF backbone. Such variance is represented by unique sequences of functionality or metal, and the very aperiodic nature of their spatial arrangement give rise to sequences and anisotropy. This presentation will be focused on how to recognize, study, and use multivariate MOF structures.

Zoom link: <https://us06web.zoom.us/j/84776467492?pwd=Q0FJU3gvQlk1MDFLYVM0Qnc3eW5tdz09>

TUESDAY 30 NOVEMBER 2021 AT 4:00 PM

Water Harvesting from Air Anytime Anywhere

Water is essential to life. It is estimated that by 2050 nearly half of the world population will live in water stressed regions, due to either arid conditions or lack of access to clean water. This presentation outlines the parameters of this vexing societal problem and presents a solution to the global water challenge. Metal-organic frameworks (MOFs) have emerged as a unique class of porous materials capable of trapping water at relative humidity levels as low as 10%, and doing so with facile uptake and release kinetics. From laboratory testing to field trials in the driest deserts, kilogram quantities of MOFs have been tested in several generations of devices. We show that the vision of having clean water from air anywhere in the world at any time of the year is potentially realizable with MOFs and so is the idea of giving "water independence" to the citizens of the world.

Zoom link: <https://us06web.zoom.us/j/86404182427?pwd=MFpFaGZvMzM3M1ptT2V1ekJUYXltUT09>

