Miniaturization to the nanometer scale regime is a very prolific strategy for the development of new materials with novel and often enhanced properties compared to traditional materials, opening up avenues for technological and biomedical applications in many areas, including drug-delivery, catalysis, diagnostics, solar cells, etc. To date, most nanoscale materials are either purely organic or inorganic in composition. However, architectures created from the supramolecular assembly of organic and inorganic components are rapidly growing as a very attractive alternative class of nanoscale molecular materials.

Traditional metal-organic materials are a fascinating family of solids created from the supramolecular association of inorganic, such as metal ions and metal-organic or inorganic clusters, and organic building blocks, including organic molecules, biomolecules and organic polymers. These bulk materials, in which both type of building blocks are assembled through metal coordination, hydrogen bonding, electrostatic interactions or π-π stacking, have the potential to be tailored to show adjustable structures, compositions and properties. As a consequence, they show promise for an impressive number of applications in gas storage, drug-delivery, diagnostics, sensing, catalysis, ion exchange or separation, magnetism, optics, etc. However, metal-organic materials in the form of traditional bulk crystalline materials do not always fulfill all specific needs for these applications. Depending upon the intended application, these materials require not only to be fabricated as bulk crystalline solids, but also miniaturized at the nanometer length scale and immobilized at specific locations on surfaces.

Since his recent creation, our group, the Supramolecular Nanochemistry & Nanomaterials, has been deeply dedicated not only to the development of novel nanoscopic metal-organic materials but also to the exploration of new synthetic methodologies for the fabrication of novel functional metal-organic nanomaterials. In this communication, we will describe our recent advances done on the synthesis, growth and nanostructuration of this particular novel class of nanomaterials, their potential properties and applications, and illustrate some of their future expectations. For example, we will show how nanoscopic dimensions provide metal-organic materials of sufficiently small sizes and excellent characteristics for their use as novel drug-delivery systems, contrast agents, encapsulating systems, etc. In addition, the recent nanostructuration of metal-organic frameworks (MOFs) on surfaces using pen-type lithography techniques, such as Fluidic Enhanced Molecular Transfer Operation (FEMTO) and Dip-Pen Nanolithography (DPN), will be presented. These techniques allow transferring desired substances on surfaces at the micro- and nanometer length scale through a SPM probe or cantilever that dispenses femtoliter droplets of a solution containing these species. During this talk, we will show how these techniques can be used to control the growth of MOF crystals at specific locations of a surface by direct delivering femtoliter droplets containing both inorganic and organic building block precursors.
REFERENCES:


