Summer School for Conductive MOFs

Metal-organic frameworks (MOFs) represent a class of crystalline coordination polymers consisting of metal ions/clusters connected by organic ligands. Profiting from their well-defined structures, high specific surface area and structural/chemical diversity, MOFs have attracted great attention as advanced materials for gas storage/separation, catalysis, and sensor. However, the conventional three-dimensional (3D) MOFs show rather low electrical conductivity ($<10^{-10}$ S cm^{-1}), due to the large separation of metal centres by multi-atom and insulating organic ligands, which largely limit their electronic applications.

Taking advantage of the porous structure, hosting guest molecules (like tetracyanoquinododimethane) in MOFs have recently been shown to significantly enhance the electrical conductivity, due to the charge transfer of guests to the metal nodes or organic linkers. In addition, linking redox-active ligands, such as 2,5-dihydroxybenzoquinone, tetrathiafulvalene and pyrazine, could also generate long-range charge transport, leading to conductivity as high as 10^{-1} S/cm. On the other hand, recent advances have disclosed that the designs of layer-stacked two-dimensional conjugated MOFs by employing planar organic ligands and square-planar metal-complex linkages inducing high delocalization of π-electrons in the 2D plane can lead to largely enhanced electrical conductivity (up to ~2500 S cm^{-1}). By far, various types of 2D *c*-MOFs have been synthesized based on benzene triphenylene, phthalocyanine, coronene and dibenzo[g,p]chrysene derivatives with functional groups (-OH, $-NH_2$, -SeH or -SH). These 2D *c*-MOF materials have been successfully integrated as electrode materials for applications in electronics, chemiresistive sensor, electrocatalysis, energy storage and superconductivity. Despite the rapid development of 2D *c*-MOFs, there still exist many challenges and opportunities in novel structures, controlled synthesis and reliable structure-property relationship as well as killer applications.

This Summer School aims to focus on chemistry, synthesis, characterization and emerging applications of conductive MOFs, to envision their potential in (opto-)electronics, magnetics, spintronics, and energy storage and conversion.

Potential topics include:

- Chemical methodologies of novel conductive MOFs
- Synthetic strategies toward single crystals, nanosheets and thin films
- Conductive MOF-composites
- Theoretical modelling of conductive MOFs

- MOFs for (opto-)electronics, such as field-effect transistors, photodetectors, sensors, superconductors, thermoelectronics, and so on.
- MOFs for magnetics and spintronics.
- MOFs for energy storage and conversion, such as batteries, solar cells, supercapacitors, electrocatalysis, photocatalysis, and so on.

Keywords:

- Metal-organic frameworks
- Conductive MOFs
- Single crystals
- MOF nanosheets
- Thin films
- Theoretical calculation
- (Opto-)electronics
- Magnetics
- Spintronics
- (Photo-)electrocatalysis
- Energy storage and conversion