Call reference number	(2023-21)
Call name	Development of chemical strategies to covalently link MOF nanoparticles into superlattices
Application Deadline	2023/05/31

Introduction and main description

BCMaterials is looking for a motivated PhD student to work in the area of metal-organic framework (MOF) superlattices.

The approach to structurally align nanoparticles that has emerged over the last years is the formation of superlattices, that are highly ordered 3D structures with periodic assemblies of nanoparticles. The fundamental advantage of assembling superlattices is the possibility to create materials with emergent and enhanced properties, which are determined by nanocrystal connectivity, interparticle interactions, various superstructure geometries, crystal symmetry, and composition.

However, the superlattice synthesis with a high degree of periodical order, desirable superlattice geometry, and large crystalline areas is challenging. Slow solvent evaporation is one of the most common approaches to assemble nanoparticles into superlattices, driven by thermodynamic control to reach high-packing density structures by maximizing the free volume entropy and minimizing the high surface energy. To achieve higher control over the assembly process, the assistance of functional moieties attached to the nanoparticle surface (e.g. DNA, proteins, polymers, dendrimers) has been also employed to facilitate interparticle interactions. So far, nearly all the reported superlattices rely on weak intermolecular forces among nanoparticles and thus, resulting in materials with limited mechanical, thermal, and chemical stability. Therefore, the development of a chemistry where nanoparticles are covalently bound into stable superlattices of macroscale order will pave the way for a wide range of novel applications and will be carry out in this project with MOF nanoparticles.

Skills and Requirements

- Master in chemistry, material science, chemical engineering already finshed or to be finsihed in this academic year.
- Fluent in oral and written English is mandatory.
- Experience in the synthesis of MOF materials and/or nanoparticles is an asset.
- Experience in material and nanoparticle characterization techniques is an asset.

Work Program / Duties / Responsibilities

The plan is to assemble MOF nanoparticles into robust crystalline lattices using covalent bonds. The working hypothesis is that the control over the nanoparticle organization is achievable via interface-mediated assembly. First we will develop reliable synthetic protocols for MOF nanoparticles with monodisperse size and shape, characterize the nanoparticles' physicochemical properties, and determine the type and quantity of accessible uncoordinated surface sites that can be used for nanoparticle connection. Then we will covlently link those

Work Program / Duties / Responsibilities
MOF nanoparticles into superlattices by employing common crystallization techniques reported in literature, such as solvent evaporation and solvent-antisolvent layering to assemble nanoparticles.

Application Procedure
Apply by submitting a motivation letter and a CV (in English) using the "Contact" button at the corresponding offer, at the "Join Us" area on BCMaterials' portal (https://www.bcmaterials.net/join-us). Your name and email address will be required for furher contact too.

Other Relevant Information
Include contact details for 2 referees or 2 recommendation letters. Able to work in an international environment. Spanish knowledge would be an advantage. The selected candidate will start working at this position at the 1st September 2023.