FUNCTIONAL NANOSTRUCTURES FOR SMART NANOMATERIALS

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The unique features of the nanoscale provide nanostructures with extraordinary physico-chemical properties that allow not only a quantitative, but also a qualitative, leap in their performance for a number of applications, ranging from catalysis to smart materials. However, pristine nanomaterials such as carbon nanostructures are often very hydrophobic and tend to aggregate, thus limiting their application, for which suitable functionalization is pivotal.[1] Our research group is interested in integrating nanomaterials (e.g., nanoparticles, graphene, carbon nanotubes, etc.) with supramolecular chemistry (e.g., self-assembled short peptides or other small molecules). For instance, we have shown that a simple tripeptide is capable of catalyzing ester hydrolysis only in its supramolecular state, however, the exact mechanisms that allow catalysis to occur for the superstructures and not for the monomer, are still under investigation.[2,3] Appropriate anchoring of such supramolecular systems onto nanostructured supports could offer new means to modulate their self-assembly, and thus their performance. In addition, integration of supramolecular systems (composed of self-assembling small molecules) with other nanomaterials (e.g., carbon nanotubes) providing different physico-chemical properties (e.g., resilience, conductivity, etc.) could pave the way to multi-functional multi-component systems for advanced performance in catalysis or other fields. Therefore, it is envisaged that the PhD candidate will develop skills 1) to correctly manipulate and characterize carbon nanomaterials 2) to correctly functionalize such carbon-based nanostructures to allow their efficient interfacing with other molecules, including those capable of forming supramolecular architectures, and 3) to synthesize and characterize the resulting supramolecular materials composed of different chemical entities towards specific function, such as supramolecular catalysis or transport. Examples of the latter components could include, but not necessarily be limited to, self-assembling short peptides, which constitute an area of research expertise of our group. This project will be highly multi-disciplinary and encompass research areas ranging from organic synthesis, to nanotechnology, supramolecular chemistry and functional materials. Therefore, the candidate is expected to learn very different techniques and demonstrate excellent knowledge of organic chemistry and a strong attitude towards entering new research areas and collaborate within a team.

References:

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3. K. L. Duncan and R. V. Ulijn, *Biocatalysis* **2015**, *1*, 67-81.