

MSE-Colloquium@NTU

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Dynamic Supramolecular Engineering of Biomaterials: Nanoscale Design, Hierarchical Organization and Macroscale Functionality

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Abstract

Nature has evolved to grow, heal materials and tissues through self-assembling processes capable of organizing a wide variety of molecular building-blocks at multiple size scales. While advances in nanotechnology, additive manufacturing are enhancing our capacity to emulate some of these biological structures. It is increasingly evident that recreation of the complexity and functionality of living systems will require new ways of thinking and building materials. This talk will present our laboratory's efforts to use supramolecular events found in nature to engineer new materials and design innovative biofabrication processes based on multicomponent self-assembly, protein order-disorder synergies, diffusion-reaction processes, and/or organic-inorganic interactions to organize multiple types of biological (e.g. proteins, polysaccharides) and synthetic (e.g. peptides, surfactants, graphene) building blocks hierarchically. The resulting materials exhibit properties such as hierarchical organization¹⁻³, the capacity to grow and heal^{2,3}, tuneable mechanical properties^{1,2} and spatially-controlled bioactivity^{4,5}.

References:

1. Elsharkawy et al (2018). Nature Communications 9(2145), 10.1038/s41467-018-04319-0.
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3. Inostroza-Brito et al (2015). Nature Chemistry 7(11), 10.1038/nchem.2349.
4. Hedegaard et al (2018). Advanced Functional Materials 28(16), 10.1002/adfm.201703716.
5. Okesola et al (2020). Advanced Functional Materials 10.1002/adfm.201906205

Biography

Dr Alvaro Mata is Professor in Biomedical Engineering and Biomaterials in the School of Pharmacy and the Department of Chemical and Environmental Engineering at the University of Nottingham. He holds a Bachelor's Degree from the University of Kansas, a Master's Degree from the University of Strathclyde, and a Doctor of Engineering Degree from Cleveland State University working with Professor Shuvo Roy at the Cleveland Clinic. He also conducted his postdoctoral training with Professor Samuel Stupp at Northwestern University. His group focuses on bioinspired and innovative strategies to build with biomolecules by integrating supramolecular chemistry, structural biology, and engineering. His work has led to seven patents or patent applications; publications in journals including Nature Chemistry, Nature Communications, Science Advances, and Advanced Functional Materials; and awards such as a Ramón y Cajal Fellowship and an ERC Starting Grant. More information can be found at: www.matabioengineering.com, twitter.com/mata_lab.