P.40 Hierarchical morphogenesis of a hybrid peptide/protein system

K E Inostroza[1,2], K H Smith[2], A Monge-Marcet[2], M Alonso[3], J C Rodríguez-Cabello[3], D S Ferreira[4], R P Rodríguez[2], R L Reis[4], F Sagués[5], H S Azevedo[1,4] and A Mata[1,2]

[1]School of Engineering & Materials Science, Queen Mary, University of London, UK, [2]Nanotechnology Platform, Parc Científic de Barcelona, Spain, [3]BIOFORGE Group, University of Valladolid, Spain, [4]3B's Research Group - Biomaterials, University of Minho, Portugal, [5]Departament de Química Física, Universitat de Barcelona, Spain

Tissue morphogenesis into hierarchical structures is a highly complex process from fast subcellular rearrangements to slow structural changes at the macroscale. Fundamental to this process are physical forces that are generated through dynamic physico-chemical interactions. The fabrication of functional macroscopic materials that can be morphed into complex shapes through directed and dynamic self-assembling mechanisms that mimic those found in tissue development has not been achieved. Here we report the development of a dynamic peptide/protein self-assembling system that through emerging physico-chemical mechanisms is able to generate and dissipate stresses to undergo morphogenesis into complex hierarchical shapes with spatio-temporal control and in real time.

Our results demonstrate that the combination of a highly collapsed Elastin-Like Polypeptide (ELP) with a self-assembling amphiphilic peptide (PA) can spontaneously form dynamic macrotubular structures. This interfacial supramolecular system has the capacity to grow, controllably disassemble, adhere and seal to surfaces, be manipulated in real time, self-heal, and self-organize into complex macroscale geometries with nanoscale order. Morphogenesis into tubular structures was dependent on ELP and PA sequence, experimental setup, electrostatic and hydrophobic interactions, and temperature. In addition to undergoing morphogenesis, tubes exhibited elasticity and could be handled and manipulated.

Our system was used to generate robust and dynamic tubular networks by directed self-assembly without the use of predefined moulds. The interfacial phenomena reported here may provide a novel material fabrication platform for developing a new kind of hybrid peptide/protein nanomaterials with potential use in tissue engineering, biosensors, and electronic devices.