Structure-function relationship in biomaterials surface science

In the quest for the next generation of functional biomaterials and new solutions in health-related research, investigators have sought inspiration from nature by developing better performing bioderived materials (e.g. chitosan, polydopamine) and architectures (e.g. nanoporosity), reproducing naturally occurring micro and nanostructures to control cellular response at the material-host tissue interface. In this context, our team has focused on understanding the effects on cells of poly(dopamine), an adhesive polymer derived from mussels, as a multifunctional layer for direct cueing to osteoblastic and mesenchymal stem cells. In addition, we have employed anodization to create reproducible patterns of nanotubes on titanium surfaces, demonstrating their role in controlling osteoblastic and mesenchymal stem cell activities. In parallel, our work has also contributed to the development of collagen-, agarose- and chitosan-based materials for applications in neuronal tissue engineering and disease modelling. For example, we focused on the creation of micro-engineered chitosan substrates for neuronal guidance and on 3D scaffolds to support neuronal adhesion and network formation.