Master Thesis Projects available at the Max-Planck-Institute for Intelligent Systems, Stuttgart

1. Development of an Artificial Nanosubmarine

Contact: Dr. Peter Oswald (oswald@is.mpg.de) / Prof. Peer Fischer (fischer@is.mpg.de)

The aim of this project is to use an enzyme as a molecular rotational engine to construct and operate an artificial "nano-submarine" that is powered by a chemical reaction (conversion of ATP to ADP) and that can swim, similar to a bacterial cell, through water. We have a genetically modified strain of the ATPase enzyme in the lab that we can couple to nanostructures and particles. The EPFL Master Thesis student will work with immobilization methods to build bio-hybrid nanostructures and test their yield, activity, and ease of handling. The student will be exposed to a variety of analytical methods (like optical fluorescence and electron microscopy, QCM-D, ELISA, etc.) to quantitatively study the function of the nanomotor-constructs. It is envisaged to generate arrays of nanomotors on a substrate that can be followed and studied with imaging methods. This project would suit someone with a physical chemistry, chemistry, or biochemistry background.

2. Multifunctional Nanoparticles with Shape Control

Contact: Dr. Andrew Mark (mark@is.mpg.de) / Prof. Peer Fischer (fischer@is.mpg.de)

We have recently developed a physical vapor deposition method that allows us to rapidly grow entire wafers with hundreds of billions of nanostructures whose material composition and shape we can easily change during the growth (Nature Materials, 12, 802, 2013). It is now possible to realize hybrid nanostructures with defined geometric shapes (e.g. helices) that cannot be made or synthesized by any other scheme. Applications include 3D shapes with defined plasmonic properties, nanostructures that can interact selectively with molecules, that have tuned optical and electrical transport properties, and to realize structures that can be used for energy applications. The EPFL Master Thesis student will learn about the fabrication, study the physical and material properties of custom hybrid nanostructures and undertake imaging. This project would suit someone with a physics, physical chemistry, or materials science background.

3. Interaction of hyaluronan species with hyaluronidases and specific hyaluronan receptors

Contact: Dr. Heike Boehm (boehm@is.mpg.de)

The polysaccharide hyaluronan is found in many tissues of the human body offering protection, often as pericellular matrix, against harmful molecules and viruses. In addition it serves as a water reservoir and provides cell-cell and cell-matrix communication. The equilibrium of long hyaluronan and its smaller degradation products through targeted synthesis and degradation is important for the survival of the cell and is prone to fluctuations, which can have numerous effects on the surrounding tissue .

For a better understanding of the binding mechanisms of differently long hyaluronan species, we examine their interaction with different hyaluronan binding proteins and hyaluronidases with the

aid of the QCM-D (quarz crystal microbalance and dissipation monitoring) method on well defined interfaces.

If you are interested to work on an interdisciplinary research project combining biophysical techniques and glycobiology, please send us your CV and letter of motivation. We look forward to meeting you.