Energy and Information transduction at the Nano-Bio Interfaces

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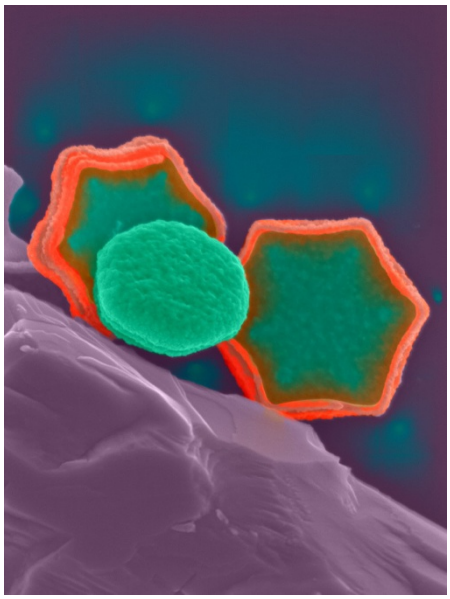
Interfacing of Nanotechnology with Biological Sciences is cross-cutting field of research that is expected to overcome emerging challenges of civilization, including sustainable energy supply, information storage and advancing of medical technologies for treatment of fatal diseases. Bionanotechnology is a multidisciplinary challenge directed to developing of novel nanoscale tools capable of guiding, controlling and altering important biological pathways. On the other hand, understanding and replication of natural mechanisms such as light harvesting and water splitting, energy and charge transfer, ionic signalling is employed to explore the use engineered nanostructures in practical devices such as nanocatalysis and advanced medical therapies.

In the first part of my talk I will focus on development of ***photocatalytic*** nanobio sysntems. One semiconductor nanopartciles and antibody-based phoptocatalyst can be applyed for photodynamic therapy of cancer [1-3]. Hard X-Ray Microprobe and Nanoprobe were employed for advanced imaging of light-induced cellular red-ox events catalysed by the nan/bio hybrid. Another hybrid photocatalyst was developed as a bio-assisted nanoassembly for light-driven hydrogen fuel genration.

In the second part of my talk I will highlight our results on development of ***magnetic*** materials for biological applications, namely interfacing of bio-functionalized magnetic materials with cancer cells for controlled magnetomechanical membrane actuation and heat delivery.

We recently demonstrated that pronounced biologically relevant effects such as programmed cell death can be achieved through use of a ***magnetically soft material*** and application of unprecedentedly weak magnetic fields of a few tens of Hz of a frequency owing to strong magneto-mechanical coupling properties of the material [4-7].

Another type of magneto-responsive hybrids, magnetic nanomicells composed of temperature-sensitive polymer and ***superparamagnetic particles*** were developed for magnetic field-mediated cargo and heat delivery [8]. Argonne Synchrotron Nanoprobe X-Ray fluorescence was applied to visualize focused platinum complex drug delivery across eukaryotic membrane to subcellular compartments associated with cellular signaling and programmed cell death.



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