Type of Position: PhD (TV-L13, 67%), Leibniz-IPHT Jena, Germany

Research Area: Physical Chemistry

Principle Investigator (PI): Dr. Maria Wächtler

Name of Institute: Leibniz-Institute of Photonic Technology, Jena, Germany

TRR234-B4: Bioinspired photoactive polydopamine/sensitizer membranes for solar-to-fuel conversion (Wächtler/ Weil)

In project B4, we will design photoactive hybrid material by embedding inorganic CdSe@CdS nanorod as photosensitizers into bioinspired redox-active, polydopamine membranes which can serve as platform for anchoring molecular catalytic reaction centers. The membranes will be used to spatially separate and electronically couple oxidative (focus: WOC/AOC) and reductive (focus: NAD+/HER) half-reactions. Membrane design will be used to access asymmetric Janus membranes which act as charge carrier between both reaction sites, facilitating transfer of electrons and selected chemical species. Optical spectroscopy will be complemented by surface sensitive vibrational sum frequency generation as key tools to elucidate mechanistic details on the light-induced coupled photoreactions.

Short description of the Job: In close collaboration with experts on natural polymers, strategies to incorporate semiconductor nanoparticles as light absorbing units into polymer membranes will be explored. Functionalized with molecular reaction centers these hybrid thin films serve as new platform for light-driven catalysis. The interaction and light-induced function-determining charge transfer processes between particles, polymer matrix and catalysts will be studied spectroscopically, e.g. applying transient absorption and time-resolved emission spectroscopy. We will derive structure-dynamics-function relationships describing the role of matrix properties and type of linking of catalysts in controlling the light-induced reactivity. A special challenge in these systems is to selectively collect information on the catalyst. which can deliver valuable information on photoreduction and or protonation und operation. For this purpose, the potential of vibrational sum frequency generation as surface selective and monolayer sensitive spectroscopic tool to observe light-induced charge accumulation at the attached catalysts, charging of the matrix, and aging effects and pH changes during operation will be explored.

The successful applicant will have strong interest in physical chemistry and properties of nanostructured materials, skills in chemical synthesis, have some previous knowledge in optical spectroscopy and is highly motivated to acquire skills in advanced spectroscopic characterization. He/she should be highly motivated to work in an interdisciplinary and international team and should have excellent written and oral communications skills in English. The position will involve frequent traveling.