



UNIVERSITÄT
BAYREUTH

Elitenetzwerk
Bayern



Elite Study Program in Macromolecular Science

Module

Functional Materials

Focus: Materials for Information, Electronics and Medical Applications

Part I: Introductory lectures

Part II: Conference International Materials Forum,

Part III: Poster presentation or Seminar

Prof. Mukundan Thelakkat

Prof. Peter Strohriegl

Prof. Hans-Werner Schmidt

Summer term 2008

One module in the summer term 2008 within the Elite Study Program "Macromolecular Science" is on "Functional Materials" focusing on functional materials for information, electronics and medical applications. The module deals with aspects in the chemistry and physics and engineering of advanced organic functional materials.

The module consists of three parts.

I. Series of introductory lectures on basic principles of organic functional materials and their application

Biomaterials

Prof. Thomas Scheibel, University of Bayreuth

During the last century synthetic polymers have aroused increasing interest, since they show a large variety of material properties allowing their application in numerous products. However, synthetic polymers do have limitations in their functionality, especially in the area of biomedical technology, where biocompatibility, -functionality, and –degradability are desired. Besides biodegradable synthetic polymers, naturally occurring biopolymers have been discovered having the desired "bio" properties in combination with "classic" properties of well established synthetic polymers. Prof. Thomas Scheibel describes proteins as one class of biopolymers and discusses their potential for material applications. In order to highlight the attractiveness of using proteins as new biomaterials, bioengineered spider silk proteins are compared to synthetic polymers regarding their physical, chemical, and mechanical properties. It will be shown that proteins offer great possibilities to produce environmentally friendly materials with new designs and properties for innovative materials of the future.

Assembling nanostructures and microstructures towards hierarchical architectures

Prof. Anna Köhler, University of Bayreuth

The introductory lecture Prof. Anna Köhler of aims at giving a basic introduction to the photophysics and device physics of organic semiconductors. First the electronic structure is presented that gives rise to the semiconducting properties of molecular crystals and disordered molecular or polymeric films. This is followed by a discussion of the fundamental photophysical processes that occur in these semiconductors such as the creation and transport of charges and excited states, or the formation of excited states that extend over adjacent molecular units. Finally is discussed how these processes allow for the efficient operation of devices such as light-emitting diodes, solar cells and transistors. While examples of current research will be included, the main intent is to give a broad induction to the novice on the exciting science in this novel and promising class of materials.

Photophysics and device physics in organic semi-conductors

Prof. Martin Steinhart, MPI Halle

In this part Prof. Martin Steinhart discusses intensively the synthesis of nanostructures and microstructures by chemical and physical methods. However, it is still a challenge to assemble the entities thus obtained into functional device architectures. This lecture addresses approaches to the generation of two-dimensional arrays and three-dimensional ensembles of nanomaterials and micromaterials. Top-down strategies such as electron beam lithography, interference lithography, nanoimprint lithography and focused ion beam techniques will be covered, as well as bottom-up approaches based on the self-organization of, for example, block copolymers and colloidal particles. Applications ranging from photonics to tissue

engineering as well as the wetting and adhesion properties of nanostructured surfaces, such as the well-known Gecko effect, will be discussed.

II. Conference participation: "International Materials Forum 2008", August 4-5

The students will attend the conference "*International Materials Forum 2008*" focusing on functional materials for information, electronics & medical applications. Highly ranked international speakers will participate, including the 2007-Nobel Laureate Peter Grünberg (Jülich), Sir Richard Friend (Cambridge, UK), Masanobu Jamamoto (Sony, Japan), Craig A. Grimes (Pennsylvania State University, USA), Michael Jaffe (New Jersey Center for Biomaterials, USA) and C. James Kirkpatrick (Mainz). Their contributions will be complemented by other lectures from well known scientists and engineers from leading institutes and companies to give an international audience a survey on the cutting edge of novel scientific approaches, developments and the potentials for innovations. This will also include an interdisciplinary dialogue among the international experts from academia and industry. To make this most efficient the number of participants is limited.

III. Poster presentation on actual research topics of the participating elite students at the conference or seminar on the scientific contribution and field of selected speakers of the conference

The participating elite students have the opportunity to present their actual research work during a poster presentation at the *International Materials Forum 2008*.

Alternatively the students will work together in interdisciplinary groups consisting of 2-3 students and prepare seminars of 30 minutes based on selected scientific contribution of the conference, which will be attended by all students participating in the module.