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Paracelsus Prize **1**

Biomimetic Synthesis of Natural Products

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The biomimetic approach to natural product synthesis will be contrasted with the widely used retrosynthetic method. Examples of the former approach will be given to support the view that in certain circumstances there are definite benefits from the biomimetic approach, in terms of simplicity and in particular the generation of molecular families.

Werner Prize **2**

Microcontact Processing for Microtechnology and Biology

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The emergence of non-conventional lithographic techniques has resulted in opportunities to extend, replace, or complement conventional surface processing methods. I will present some of our activities in IBM on microcontact processing where soft lithography is combined with self-assembly in an attempt to provide a broad technological platform for use in microtechnology and biology. Self-assembling systems are, however, "fragile" and the recurrent difficulty of changing their driving mechanisms so as to optimize process parameters limits their use in technology. I will describe in a particular example how a hyper-selective wet etch system for microcontact printed self-assembled monolayers can be devised.[1] Such an etch system permits, for example, electroless deposited metals on large substrates to be structured. This work may spur the introduction of novel surface chemistry processes into flat-panel-display fabrication.[2] Similarly, non-conventional surface processing techniques that are able to "handle" biomolecules and pattern them on surfaces provide tantalizing opportunities for miniaturizing biological assays. I will briefly describe two methods based on microcontact printing[3] and microfluidics[4] which can accurately pattern biomolecular receptors on surfaces. Such miniaturized assays have the attendant benefits of preserving samples and reagents, parallelization, faster time to results, and may result in portable bioanalytical devices having great performances.

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Gramaticakis – Neumann Prize 2006 **3**

**DNA Photonics –
Probing Light-Induced Dynamics
in DNA on the Femtosecond Time Scale**

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The *first generation* of experiments on photoinduced electron transfer (ET) in DNA has spawned a basic mechanistic picture from which simple kinetic models were derived. In these models ET through the base stack has been reduced to a static donor-bridge-acceptor problem. Recent experimental and theoretical results have demonstrated that structural dynamics are critical for a comprehensive mechanistic understanding of the ET process. While the initial controversies regarding the long-range conductivity properties and wire-type behavior of DNA have been settled, a new field, DNA Photonics, has emerged around the photophysics of nucleic acids. The contributions that can be expected from future studies in **DNA Photonics** will likely answer the question whether - and to what extend - DNA can be used as a functional building block in molecular nanoscale devices. They will also be focused on the complex interactions between structural and electronic properties of DNA which are profound for biomedical applications such as DNA-targeted drug design. In this paper we report about our recent experimental efforts which are part of the *second generation* of studies to expand the new and highly exciting field of **DNA Photonics**. Experimental data from several different classes of functionalized DNA systems will be presented to illuminate the relationship between structural dynamics and charge injection/migration using state-of-the art femtosecond broadband spectroscopy. Our results present strong evidence for the involvement of hydrogen bond dynamics which must be considered as a specific mode of solvation dynamics inside the DNA helix. Finally, we emphasize the importance of the initial electronic excitation. Thus, ultrafast electronic energy migration, dissipation and (de)localization must be included into the theoretical description of light-induced dynamics in DNA.

SCS Gramaticakis – Neumann Prize 2006 **4**

Chromophore-Functionalized DNA: From Photoinduced Electron Transfer to Applications in Fluorescent DNA Analytics

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Electron transfer (ET) reactions represent an exciting research field in chemistry as well as in biology. In particular, the biomacromolecule DNA as an interesting functional π-system and a unique medium for electron transfer has attracted a considerable amount of research efforts. We focused our work on the spectroscopic and chemical investigation of excess electron transfer. New photochemical assays consisting of chromophore-modified oligonucleotides have been synthesized and developed which give new insights into the mechanism of these processes.
Important ways to create such DNA assays are either the replacement of DNA bases by chromophores or the attachment of fluorophores to common DNA bases. The resulting artificial or modified DNA bases can be used to photoinitiate electron transfer through the DNA which results in a characteristic modulation of the emission properties. Moreover, the applied fluorescent probes that are sensitive to the local environment within DNA duplexes represent important tools for DNA hybridization. Both fluorescence changes can be applied in DNA analytics, e. g. for the detection of physiologically relevant single base mismatches.

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