BP 3: Symposium SKM Dissertation-Prize 2014

Time: Monday 11:00–12:40 Location: CHE 89

Invited Talk BP 3.1 Mon 11:00 CHE 89

Interplay of ordering behavior and optical properties in organic semiconductor blends — •Katharina Broch — Universität Tübingen, Institut für Angewandte Physik, Auf der Morgenstelle 10, 72076 Tübingen, Germany

Binary mixtures of organic semiconductors (OSCs) have recently become an important field of research due to their potential applications in opto-electronic devices. In these systems, the mixing (intermixing vs. phase separation) and ordering behavior is crucial, since it affects the optical and electronic properties. Investigating binary mixtures of the three prototypical OSCs pentacene (PEN), perfluoropentacene (PFP) and diindenoperlyene (DIP) in all possible combinations, allows to study systematically the influence of the competing effects of favorable intermolecular interactions and steric incompatibility on film structure and optical properties. The focus of the talk will be on the optical spectra determined post-growth, for which the impact of intermolecular interactions, including charge transfer [1], and of differences in mixing and ordering behavior on the spectral shape and peak positions will be discussed [2]. In particular, for PEN:DIP an anisotropic ordering behavior, comparable to that observed in some liquid crystals, is found, which is fundamentally new for OSCs [3] and which opens possibilites for a targeted tuning of intermolecular interactions in blends. [1] K. Broch et al., Phys. Rev. B, 83 (2011), [2] K. Broch et al., J. Phys. Chem. C, 117 (2013), [3] A. Aufderheide et al., Phys. Rev. Lett., 109 (2012).

Invited Talk BP 3.2 Mon 11:25 CHE 89

Fingerprints of Geometry and Topology on Low Dimensional Mesoscopic Systems — •Jan Carl Budich — Department of Physics, Stockholm University, SE-106 91 Stockholm, Sweden

Triggered by the discovery of the quantum spin Hall effect in two dimensional time reversal symmetric insulators, the impact of topology on the physics of Bloch bands has been systematically studied in recent years culminating in the formulation of a periodic table of topological insulators. We demonstrate the close analogy between geometric phases occurring in quantum systems that adiabatically depend on time via external control parameters and the formal description of topological insulators. While geometric phases may have immediate observable consequences, the experimental implications of the intrinsic topological features of band structures can be much more subtle. As for the mentioned quantum spin Hall state, the salient experimental signature of bulk topology is the necessity of metallic edge states characterized by the locking of spin and momentum. This peculiar constraint leads to novel quantum transport effects relating to the field of spintronics. We discuss how these phenomena are influenced by the presence of electronic correlations and by a finite bias voltage driving the edge channels out of thermal equilibrium, respectively.

Invited Talk BP 3.3 Mon 11:50 CHE 89

Spin injection into GaAs - the spin solar cell and spin photodiode — •Bernhard Endres, Mariusz Ciorga, Maximilian Schmid, Martin Utz, Dominique Bougeard, Dieter Weiss, Christian Back, and Günther Bayreuther — Universität Regensburg

Efficient spin injection into semiconductors is a prerequisite for the realization of spintronic devices which primarily make use of the electron spin orientation for data storage and information processing. In III-V semiconductors, a sizable spin polarization can be created by illumination, requiring circularly polarized light at a well-defined wavelength. In contrast, we demonstrate the spin solar cell effect as a new and efficient method for optical spin generation without these restrictions [1]. A laser beam is used to create electron-hole pairs in a (Ga,Mn)As\n-GaAs p-n-junction and to detect the spin accumulation via the magneto-optic Kerr effect (T=15 K). The photo-voltage causes electrons to tunnel across the narrow barrier from the n-GaAs into the (Ga,Mn)As. Since tunneling into (Ga,Mn)As is spin-dependent, spin-polarized electrons accumulate in the n-GaAs. A second working mode, the spin photodiode effect, is realized by applying a negative voltage to the (Ga,Mn)As contact which drives optically excited spins of reverse polarity from the (Ga,Mn)As conduction band into the GaAs layer. This new approach to convert light of arbitrary polarization into spin current is expected to work at room temperature and allows adaptation to different ferromagnets like Fe on mainstream semiconductors like Si.

[1] B. Endres et al., Nature Commun. 4, 2068 (2013).

Invited Talk BP 3.4 Mon 12:15 CHE 89

Unraveling the impact of subsurface and surface properties of a material on biological adhesion - a multi-scale approach — •Peter Loskill[1], Hendrik Hähl[1], Markus Bischoff[2], Kellar Autumn[3], Mathias Herrmann[2], and Karin Jacobs[1] — [1]Experimental Physics, Saarland University, D-66041 Saarbrücken, Germany — [2]Institute of Medical Microbiology and Hygiene, Saarland University, 66421 Homburg/Saar, Germany — [3]Department of Biology, Lewis & Clark College, Portland, OR 97219, USA

Understanding the adhesion of biological objects to inorganic surfaces is an important research objective in physics and the life sciences. To characterize biological adhesion, most studies describe a substrate solely by its surface properties; the composition of the material beneath the surface is frequently overlooked. That way, long-range van der Waals (vdW) interactions are disregarded. This work reveals that biological objects of all scales - nanoscopic proteins, microscopic bacteria, and macroscopic geckos - are influenced by nanoscale differences in the interface potential. By using tailored silicon wafers with a variable silicon oxide layer thickness, the vdW part of the interface potential is tuned independently from the surface properties. By modifying the wafers with silane monolayers, the surface chemistry can be varied separately as well. On these model substrates, adsorption and adhesion experiments were performed. Protein adsorption was investigated by in situ X-ray reflectometry, bacterial adhesion was explored via AFM force spectroscopy with bacterial probes, and gecko adhesion was characterized using a mechanical testing platform.