PCSI

Room Ballroom South - Session PCSI-ThM

Grande Finale

Moderator: Chris Palmstrom, University of California, Santa Barbara

8:30am **PCSI-ThM-1 Spin-Dependent Processes in Organic Solar Cells: Recombination at Bulk Heterojunctions**, ***Martin Brandt***, Walter Schottky Institut, Technische Universität München, Germany; *A Kupijai,* Walter Schottky Institute/Technische Universität München, Germany; *K Behringer, F Schaeble, N Galfe, M Stutzmann,* Walter Schottky Institut, Technische Universität München, Germany **INVITED**

Spin selection rules govern electronic transport and can therefore be used to identify important transport processes. Electrically detected magnetic resonancd provides an extensive toolbox for this purpose with its recently developed techniques based, e.g., on spin locking and electron double resonance. It is partucularly informative when spin pairs are studied, where the constituents can be easily distinguished spectroscopically.

In this talk, studies of the domnant spin-dependent processes in organic solar cells are summarized using bulk heterojunctions of PCBM and P3HT or PCDTBT. At low temperatures, we identify the recombination of bipolar polaron pairs as the dominant processes and determine the time constants characteristic for this recombination. With increasing temperatures, the negative PCBM polaron becomes invisible. At room temperature, we find the spin-dependent transport in P3HT/PCBM to be governed by a recombination process involving two spin species in P3HT, the positive polaron and a hitherto unreported, possibly defect-related state. We introduce electrically detected magnetic resonance as a method, briefly review its range of applications and discuss the results obtained on our organic devices as a function of temperature and bias voltage.

9:00am **PCSI-ThM-7 Exciton Spin Dynamics in Hybrid Organic-inorganic Perovskites**, *P Odenthal, W Talmadge, N Gundlach, R Wang, C Zhang, D Sun,* University of Utah; *Z Yu,* Washington State University; *Z Vardeny,* ***Yan Li,*** University of Utah **INVITED**

The hybrid organic-inorganic perovskites have emerged as a new class of semiconductors which make excellent solar cells with an efficiency over 20%. They are also highly promising semiconductors for the field of spintronics due to their large and tunable spin-orbit coupling, spin dependent optical selection rules, and predicted electrically tunable Rashba spin splitting. I will present our latest study of exciton spin dynamics on the solution processed polycrystalline $CH_3NH_3PbCl_xI_{3-x}$. With time-resolved Faraday rotation (TRFR) and optical Hanle measurements, we demonstrate the optical orientation and quantum beating of excitons in the perovskites, which confirms the spin-dependent optical transitions. The energy dependence of the Faraday rotation follows the exciton absorption band at low temperatures, confirming its excitonic origin. The TRFR in zero field reveals unexpected long spin lifetimes exceeding 1 ns at 4K, given that Pb and I exhibit large spin-orbit coupling, and usually lead to fast spin relaxation. Application of a transverse magnetic field causes quantum beating at two distinct frequencies, and the approximate linear relationships give two g-factors, which we tentatively assign to electrons and holes as $g_e = 2.63$, and $g_h = -0.33$. Temperature dependence and power dependence of the spin lifetimes reveal some clues to the spin relaxation mechanisms.

9:30am **PCSI-ThM-13 Group IV-SiGeSn Core/Shell Nanowires**, ***Simone Assali,*** *A Attiaoui, O Moutanabbir,* École Polytechnique de Montréal, Canada **INVITED**

Sn-containing Si and Ge alloys in an emerging family of semiconductors with the potential to impact group IV materials-based devices. Indeed, the ability to independently engineer both lattice parameter and band gap holds premise to develop enhanced or novel photonic and electronic devices. The ability to incorporate Sn atoms into silicon and germanium at concentrations about one order of magnitude higher than the equilibrium solubility is at the core of these emerging class of semiconductors. Combining the unique properties of SiGeSn with the flexibility in design and fabrication offered by nanowires creates a wealth of opportunities to implement innovative devices. With this perspective, in this presentation we will address the epitaxial growth and stability of these metastable semiconductors with focus on core-shell nanowires. We will discuss their optical and electronic properties based on theoretical and experimental investigation. Strategies to integrate these nanowires in fabrication of optoelectronic devices will also be presented.

Author Index

Bold page numbers indicate presenter