MM 17: Functional Materials I

Time: Monday 15:45–17:00 Location: IFW D

MM 17.1 Mon 15:45 IFW D

Fabrication of perovskite nano-rods in nanoporous anodic-aluminum oxide and their light harvesting characteristics — •Mirko Gabski, Martin Peterlechner, and Gerhard Wilde — Institute of Materials Physics, University of Münster, Germany

Anodic-aluminum oxide (AAO) membranes consist of a highly ordered uniform hexagonal pore arrangement with pore diameters from ∼10 to ∼200 nm, and a thickness between ∼10 nm and >100 μm [1]. AAO membranes are comparably cheap and easy to synthesize, thus excellent for the synthesis of quasi-one-dimensional nano-rods.
Organometal-trihalide perovskites are organo-metal salts which are used as sensitizer in dye-sensitized solar-cells and as a light harvester in solid-state thin-film perovskite solar-cells,
with efficiencies up to ∼20 % [2].
The aim of this work is the fabrication of light harvesting devices, consisting of an ordered array of perovskite nano-rods that operate as quasi-one-dimensional perovskite solar-cells in parallel circuit. The nano-scaled confinement should result in preferred direction for charge carrier transport. Deposition conditions and resulting structures are studied, applying co-evaporation or precipitation from a highly concentrated perovskite solution. Optimum process parameters leading to a maximum filling of the AAO are deduced.
References:
[1] Y. Lei, W. Cai, G. Wilde, Prog. Mater Sci. 52 (2007) 465-539
[2] H. Snaith, J. Phys. Chem. Lett. 2013, 4, 3623-3630

MM 17.2 Mon 16:00 IFW D

Fabrications of Nanoporous Film and Nanowire Arrays with High Gas-Sensing Performances — •Shipu Xu, Huaping Zhao, Rui Xu, Liaoyong Wen, and Yong Lei — Institute of Physics & Institute of Micro- and Nanotechnologies (ZIK MacroNano), Ilmenau University of Technology, 98693 Ilmenau, Germany

Gas sensing has an important effect on many aspects in our society, and has gained much progress by nanostructuring materials. Herein, nanoporous film and nanowire arrays were respectively fabricated on the device substrate and directly used as the sensing platform. Different kinds of N- and P-type sensing materials (e. g., SnO2, Fe2O3 and NiO) were independent or composited with graphene to serve as functional materials. Given by the intrinsic advantages of nanostructuring (e. g., large specific area and rich active sites), as-prepared sensors had exhibited high-sensitive and rapid sensing response in the ambient atmosphere even at room temperature. Furthermore, the pristine sensing property could be manipulated by their nanostructures, such as surface pore size of porous film or the length of nanowire arrays, to meet the requirements of the practical applications. Obviously, the way to improve and manipulate the sensing property that based on the nanostructuring (e. g., nanoporous film and nanowire arrays) enables the feasibility of next-generation gas-sensor.

MM 17.3 Mon 16:15 IFW D

Compact Nanowire Sensors Probe Microdroplets — Julian Schütt[1], Bergoi Ibarlucea[1,2], Rico Illing[1,2], Felix Zoergiebel[1,2], Sebastian Pregl[1,2], Daijiro Nozaki[1], Walter Weber[2,3], Thomas Mikolajick[2,3], Larysa Baraban[1,2], and •Gianaurelio Cuniberti[1,2] — [1]Max Bergmann Center of Biomaterials and Institute for Materials Science, Dresden — [2]Center for Advancing Electronics Dresden — [3]Namlab GmbH, Dresden

Here we demonstrate a first combination of droplets microfluidics with the compact silicon nanowire field effect transistor (SiNW FET) in the microfluidic channel for in flow electrical detection of aqueous reactor-drops. Apart from detection events, we chemically probe the content of numerous droplets in a row as independent events (up to 10^4), and resolve the pH values and ionic strength of the solution, resulted in a change of a source-drain current ISD through the nanowires. We demonstrate the capability of the novel droplets based nanowire platform for bioassay applications and carry out a glucose oxidase (GOx) enzymatic test for glucose detection. Optic-less and noninvasive measurements of these parameters in aqueous droplets have a great impact on the area of biodetection and bioanalytics as a HTS tool for pathogens, drug assays, and evaluation of the enzymatic activities.

MM 17.4 Mon 16:30 IFW D

Multiplexing of imperceptible temperature sensor arrays for on-skin applications — •Tetiana Voitsekhivska, Jürgen Fassbender, and Denys Makarov — Helmholtz-Zentrum-Dresden-Rossendorf e.V., Dresden, Germany

Beside the direct temperature measurement resembling the standard health indicator, the access to the body core temperature and its temporal variations provides the information, which is absolutely crucial to assess the psycho-physiological conditions of the patient, e.g. level of stress. To measure spatial and temporal temperature gradients, multiple temperature sensors have to be attached and processed on the human body surface [1, 2].

Here, we introduce a thermal characterization technology for real - time monitoring the human body temperature using arrays of highly compliant on-skin temperature sensors, realized on 6-micrometer-thick polymeric foils, which are haptically not perceived when worn on the skin. Beside the realization of the arrays of imperceptible temperature sensors, we put strong emphasis on the integration of a multiplexing unit on flexible foils in order to achieve measurements with mapping capabilities.

[1] R. Chad Webb et al., *Nature Materials* **12**, pp. 938-944 (2013).
[2] Tomoyuki Yokota et al., *PNAS* **112**, pp. 14533-14538 (2015).

MM 17.5 Mon 16:45 IFW D

Diamondoid-based materials for sensors, nanopores, and molecular devices — Bibek Adhikari[1], Ganesh Sivaraman[1], Frank C. Maier[1], Rodrigo G. Amorim[2,3], Ralph H. Scheicher[2], Sheng Meng[4], and •Maria Fyta[1] — [1]Institute for Computational Physics, University of Stuttgart, Germany — [2]Department of Physics and Astronomy, Materials Theory, Uppsala University, Sweden — [3]Universidade Federal Fluminense, Departamento de Física, Volta Redonda/RJ, Brazil — [4]Institute of Physics, Chinese Academy of Sciences, Beijing, China

Diamondoids are tiny hydrogen-terminated diamond-like cages which can assume a variety of sizes, have tunable optoelectronic properties, and can be selectively modified. Based on these properties, we investigate the used of diamondoids as functionalization molecules. First, we prove that small diamondoids can form measurable hydrogen bonds to small molecules, such as DNA nucleobases and can render nanopores highly biosensitive. We next investigate different molecular anchors, thiols and carbene molecules, to functionalize metal surfaces, with a prospect to use these in field emitting devices. We extend this study by examining diamondoid-based molecular break-junctions and link their efficiency to their exact microstructure and the relevant experimental conditions. Our investigations are based on quantum-mechanical calculations together with the non-equilibrium Green's functions formalism and the evaluation of the electronic and quantum transport properties of the diamondoid-based materials. We discuss the relevance of our results in using diamondoids in novel applications.