DS 11: Thin Film Application

Time: Wednesday 11:00–12:15 Location: SCH A 315

DS 11.1 Wed 11:00 SCH A 315

Resonante Mikrowellenabsorberschichten für Fusionsreaktoren — •Andreas Hentrich — Universität Stuttgart

Um einen Fusionsreaktor zu betreiben wird ein Heizsystem benötigt, im Falle des ITERs ist das eine Mikrowellenheizung bei 170GHz. Dies impliziert aber direkt, dass entsprechende Absorber vorhanden sein müssen, die den extremen Bedingungen innerhalb eines Fusionsreaktors standhalten. Ebendiese wurden für den ITER in Form einer gemischten Metall-Oxid-Schicht realisiert. Da geläufige Mikrowellenabsorber platzintensiv sind, wurde ein resonanter Absorptionsmechanismus genutzt, was Absorptivitäten von über 90% bei Schichtdicken von rund 100μm ermöglicht.

Der Absorptionsmechanismus wurde sowohl im Modell als auch durch Messungen verifiziert und quantifiziert. Es wurden die Reflektivitäten von vier verschiedenen Materialsystemen winkel-, schichtdicken- und polarisationabhängig bestimmt. Deren Materialeigenschaften wurden mit Hilfe der Modelle bestimmt und damit die Schichten hinsichtlich ihrer Absorptionseigenschaften optimiert.

DS 11.2 Wed 11:15 SCH A 315

The effect of photon recycling and back-grading on CIGS cell performance — •Seçil Güler[1,2], Uwe Rau[1,3], and Thomas Kirchartz[1,2] — [1]IEK-5 Photovoltaik, Forschungszentrum Jülich — [2]NST and CENIDE, Universität Duisburg-Essen — [3]Faculty of Electrical Engineering and Information Technology, RWTH Aachen University

Photon recycling, i.e. the reabsorption of photons created by radiative recombination within the solar cell, is the missing link between Shockley-Queisser model and classical diode theory. In order to determine the thermodynamic limits of solar cells, it is therefore necessary to consider the photon recycling process. This study aims at calculating the theoretical efficiency limits of Cu(In,Ga)Se2 (CIGS) solar cells using 1-dimensional drift-diffusion solvers by including the effect of photon recycling and bandgap grading. Simulations of current-voltage curves were performed by changing limiting factors such as back grading, back surface recombination velocity, electron and hole mobilities, and Shockley-Read-Hall (SRH) lifetime as well as the back reflection at the interface of the Mo/CIGS structure. We investigate under which circumstances photon recycling has a significant effect on device performance and study the optimum bandgap grading for different material properties.

DS 11.3 Wed 11:30 SCH A 315

Strategies to obtain chiral perovskites via surface modification — •Markus Heindl[1,2], Tim Kodalle[3], Natalie Fehn[2], Lennart Reb[2], Shangpu Liu[1,2], Constantin Harder[2,4], Maged Abdelsamie[3], Lissa Eyre[2,5], Ian Sharp[2], Stephan Roth[4,6], Peter Müller-Buschbaum[2], Alexander Urban[7], Aras Karouzian[2], Carolin Sutter-Fella[3], and Felix Deschler[1] — [1]Heidelberg University, Heidelberg, Germany — [2]Technical University of Munich, Garching, Germany — [3]Lawrence Berkeley National Laboratory, Berkeley, USA — [4]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [5]University of Camebridge, Camebridge, Great Britain — [6]KTH Royal Institute of Technology, Stockholm, Schwede, — [7]Ludwig-Maximilians-Universität, Munich, Germany

The generation, manipulation and detection of light is a key requirement for a wide range of technologies. Thus, this field is in the constant focus of further technological advancement. Recent discoveries on the design of chiral metal-organic perovskites now promise cheap, sustainable materials for energy efficient generation and detection of polarized light. However, so far, the available pool of chiral perovskite materials is limited to a few one- and two-dimensional crystal structures.

Here, we present novel strategies to produce perovskite thin films with chiral surface modification directly. The resulting compound displays strong circular dichroism effects in the blue spectral region, which can be adjusted in their intensity by varying synthetic parameters. Furthermore, we perform an extensive structural investigation into the origin of these phenomena utilizing XRD and GIWAX experiments.

DS 11.4 Wed 11:45 SCH A 315

All-oxide thin-film varactors with Mn- and Ni-doped (Ba,Sr)TiO_3 for microwave applications — •Yating Ruan[1], Stipo Matic[2], Alexey Arzumanov[1], Philipp Komissinskiy[1], Rolf Jakoby[2], and Lambert Alff[1] — [1]Advanced Thin Film Technology, Institute of Materials Science, Technische Universität Darmstadt, Darmstadt, Germany — [2]Microwave Engineering and Technology, Technische Universität Darmstadt, Darmstadt, Germany

With a trend toward miniaturization of modern electronics, tunable microelectronic devices operating over a wide range of frequencies are required for mobile communications, high-speed data connections with the upcoming 5G and Internet of Things (IoT) technologies.

Here we present all-oxide thin-film tuneable capacitors (varactors) with single-crystalline films of a tunable dielectric perovskite $Ba_xSr_{1-x}TiO_3$(BST) doped with Mn and Ni, grown epitaxially by pulsed laser deposition on a highly conducting thin-film oxide $SrMoO_3$ bottom electrodes with a room-temperature resistivity of 30 $\mu\Omega$cm. A partial substitution of the tetravalent Ti at B-sites of the BST perovskite structure with Mn and Ni in a trivalent or divalent state decreases a concentration of oxygen vacancies in the BST, leading to a reduction of the leakage current density of the varactor by 5 orders of magnitude down to 1 A/m^2. The low leakage current allows the thickness of the BST layers to go below 50 nm, enabling varactors tunable with low voltages.

DS 11.5 Wed 12:00 SCH A 315

Finite Volume Modeling of Two-Dimensional Memristive Devices for Neuromorphic Computing — •Benjamin Spetzler[1], Dilara Abdel[2], and Patricio Farrell[2] — [1]Technische Universität Ilmenau, Ilmenau, Germany — [2]Weierstrass Institute, Berlin, Germany

In recent years, memristive devices have shown considerable potential for realizing synaptic functionalities in neuromorphic computing systems. Here, we present numerical models to analyze the hysteretic behavior of memristive devices. A finite volume model self-consistently solves the semiconductor equations for the electrostatic potential and the quasi-Fermi levels of electrons and holes. Further, we include the dynamics of mobile dopants and briefly discuss the boundary conditions implemented for the calculation of the switching dynamics and the current-voltage characteristics. Simulations are compared with measurements on two-dimensional flake devices based on MoS2. The results are used to validate the simulations and discuss the underlying switching mechanisms. Implications for the design of memristive devices are derived and discussed.

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