DS 18: Thin Oxides and Oxide Layers 1

Time: Wednesday 15:00–16:00 Location: H14

DS 18.1 Wed 15:00 H14

Simulation analysis of sneak paths effect in the memristor-based crossbar topology — •Ziang Chen[1,2,3], Hao Cai[1,2,3], Christopher Bengel[4], Feng Liu[5], Xianyue Zhao[1,2,3], Heidemarie Schmidt[1,2], Stephan Menzel[5], and Nan Du[1,2,3] — [1]1)*FSUJena, Jena, Germany — [2]2)*IPHT, Jena, Germany — [3]3)*TU Chemnitz, Chemnitz, Germany — [4]4)*RWTH Aachen, Aachen, Germany — [5]5)*FZJ, Juelich, Germany

The high demand for performance and energy efficiency poses challenges for computing systems. The memristor-based crossbar architecture is enthusiastically regarded as a potential competitor to traditional solutions. Nonetheless, due to the lack of a switching control per cell, the memristor-based crossbar architecture suffers from the sneak paths that limit the range of accurate operation of the crossbar array. In this talk, the memristor-based passive crossbar geometry is studied and different topological patterns-one word line pull-up (OneWLPU) and all word line pull-up (AllWLPU)-is presented. In the worst-case scenario of two crossbar topological patterns, the read margin is defined as an accurate estimation for the sneak paths effects. For suppressing the sneak paths effects, in the Cadence simulation of two crossbar topological patterns based on the mathematical memristor model, the relevance between the read margin and other functional elements in the crossbar topology, i.e. pull-up resistance, line resistance, On/Off ratio, is revealed and analyzed. This work offers a beneficial reference and feasible solutions for the future optimization of crossbar topology with the intention of diminishing sneak paths effects.

DS 18.2 Wed 15:15 H14

Mapping the local strain distribution of oxide membranes using polarization-dependent micro-Raman spectroscopy — •Matthias T. Elm, Alexander Konetschny, Marcel Weinhold, Christian Heiliger, and Peter J. Klar — Justus-Liebig University, Gießen, Germany

Free-standing ceramic membranes are of great interest for miniaturized electrochemical devices, such as micro-solid oxide fuel cells, sensors or memory devices. Free-standing membranes exhibit residual strain, which alters the electrical conductivity and, thus, the performance of the device. Detailed knowledge of the local strain distribution in the membrane is therefore of paramount importance. Here, we show that the local strain state of the membrane can be monitored using polarization dependent micro-Raman mapping. Due to the residual strain the triply degenerate F_{2g} mode splits and the contribution of their Raman intensity to the overall Raman signal depends on the measurement geometry and the polarization of the incoming and scattered light. Varying the polarization of the incoming excitation light results in different averaging of the Raman-active modes. These results clearly demonstrate that polarization-dependent Raman measurements have the potential to yield additional insight into the local strain distribution in free-standing oxide membranes.

DS 18.3 Wed 15:30 H14

Soft RIXS study of alumina-titania thin films heterostructure to reveal the nature of 2-dimensional electron system — •Deok-Yong Cho — Department of Physics, Jeonbuk National University, South Korea

Al2O3/TiO2 binary oxide heterostructure is a novel 2-dimensional electron system (2DES) compatible with mass production. The electronic structure of the 2DES was examined using resonant inelastic soft X-ray scattering. The TiO2 thickness-dependent evolution in the Ti L3-edge energy loss features unequivocally evidenced the presence of Ti3+ state at the interface and a substantial electron-phonon coupling effects. This suggests that the 2DES properties can be controlled via well-established TiO2 engineering so that the binary oxide heterostructure would be a promising candidate for 2DES-based device application.

This work was done in collaboration with Yu-Cheng Shao, Cheng-Tai Kuo, Xuefei Feng and Yi-De Chuang (Advanced Light Source, USA), and Tae Jun Seok, Ji Hyeon Choi and Tae Joo Park (Hanyang University, South Korea). DOI: 10.1002/adfm.202104430

DS 18.4 Wed 15:45 H14

Tuning the electrochemical properties of multifunctional CoO_x catalyst layers by plasma-enhanced atomic layer deposition — •Matthias Kuhl, Gabriel Grötzner, Laura Wagner, Alex Henning, Ian Sharp, and Johanna Eichhorn — Walter Schottky Institute, Technical University of Munich, Munich, Germany

Artificial photosynthetic systems are often limited by the poor efficiency and material instability of photoelectrodes under harsh PEC conditions. One strategy towards stable and efficient systems is to interface the semiconductor light absorber with conformal and ultrathin catalytic layers, which still permit interfacial charge transport and minimize losses due to parasitic light absorption. In this context, conformal, biphasic Co_3O_4/$Co(OH)_2$ catalyst layers were fabricated by means of plasma-enhanced atomic layer deposition (PE-ALD), which are simultaneously robust and electrochemically active. The nanocrystalline Co_3O_4 layer forms a durable interface to the substrate and the disordered $Co(OH)_2$ surface layer significantly improves the electrocatalytic oxygen evolution reaction activity. Here, we show that nonsaturated oxidation reactions can be applied to tune catalytic activity, chemical stability, and physical properties of the PE-ALD layer by leveraging low plasma exposure time and low plasma power. Based on these insights, the CoO_x films are interfaced with polycrystalline semiconductor thin films to generate highly stable and efficient multilayer photoelectrode assemblies. Overall, this work highlights the use of PE-ALD as a promising approach for engineering catalyst/semiconductor interfaces to create efficient and stable photoelectrodes.