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Synthese · Modellierung · Bauteil · Charakterisierung · Elektrische Ermüdung

Sonderforschungsbereich 595
Elektrische Ermüdung in Funktionswerkstoffen

TECHNISCHE UNIVERSITÄT DARMSTADT

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Prof. Elizabeth Dickey
North Carolina State University

Electric Field Driven Point Defect Redistribution in Rutile TiO_{2-x}

The redistribution of intrinsic charged point defects under applied voltage bias leads to spatial heterogeneities in the stoichiometry. When the electrodes are impermeable to mass transport, an accumulation of point defects in the near-electrode region can lead to the local electronic carrier concentration enhancement at the interface. Such defect redistribution is responsible for the time-dependent increases in the leakage current in many devices. While this leakage current enhancement is detrimental in capacitor devices, the phenomenon of lattice defect migration can be utilized to form novel functional behaviors, such as resistive switching in metal-oxides via modulation of the interface Schottky barrier at the reverse-biased cathode.

This research combines electrical characterization measurements with electron microscopy analyses to understand the mesoscopic redistribution of point defects as a function of electric field and time. Rutile TiO2 single crystals are equilibrated at specific oxygen partial pressures and temperatures to define the initial defect chemistry state, and platinum electrodes are deposited to establish Schottky contacts. The samples are then subjected to electric fields up to 200V/cm, while the leakage current is continuously monitored.

During the degradation process the migration and accumulation of the positively charged defects, e.g. oxygen vacancies and titanium interstitials, results in Schottky barrier modulation at the reverse-bias electrode. As the electric field is increased to higher levels, the concentration of point defects at the interface increases to the point that rutile TiO2-x is thermodynamically unstable. The severe nonstoichioimety in the near-electrode regions induces microstructural defects such as dislocations, planar shear defects. The implications of this defect redistribution processes and its reversibility are discussed within the context the overall electrical transport characteristics.

Der Vortrag findet um **10:30 Uhr** im Gebäude der Materialwissenschaften, Lichtwiese, Alarich-Weiss-Str. 2, **Raum 77** statt