

MM 5: Non-equilibrium Phenomena in Materials Induced by Electrical and Magnetic Fields 1

Time: Monday 15:00–15:30

Location: H44

Topical Talk

MM 5.1 Mon 15:00 H44

Vacancy transport in oxides exposed to high electric fields —

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Internal electrochemical redox reactions and accumulation of charge in oxides are treated. Internal reactions shall lead to electronic conduction in the reduced and oxidized regions near cathode and anode respectively. Several scenarios for the generation and transport of charged oxygen vacancies and the attainment of steady state are discussed. It will be shown that at high cell voltages the characteristic

time for reaching steady state, also called incubation time, is smaller than the characteristic time for the growth of reacted regions. Then the incubation time is inverse proportional to the squared cell voltages or the voltage drop across the oxide, respectively. Examples where this relation is fulfilled are given for electromigration in integrated circuits, formation of memristors, flash sintering of ceramics and degradation of high-k materials. In addition, diffusion coefficients for vacancies evaluated from incubation times of yttria stabilized zirconia (YSZ) agree with extrapolated measured values. Internal reactions will also play a role in solid oxide fuel cell (SOFC) and solid oxide electrolysis cells (SOEC), where current densities may exceed the reaction rates with gases at the porous electrodes.