MA 19: Magnetic Half-metals and Oxides II

Time: Wednesday 15:15–16:45 Location: H22

MA 19.1 Wed 15:15 H22

Phase diagram of $(La_{1-y}Pr_y)_{0.67}Ca_{0.33}MnO_3$ thin films: structural, magnetic and transport data — •Sebastian Hühn, Camillo Ballani, Markus Jungbauer, Kai Gehrke, Vasily Moshnyaga, and Konrad Samwer — 1. Physikalisches Institut, Universität Göttingen

Colossal magnetoresistance (CMR) has been extensively studied in prototypic $(La_{1-y}Pr_y)_{0.67}Ca_{0.33}MnO_3$ (LPCMO) bulk material [1], in which Pr substitution (y) provides a way to control the electron-lattice coupling. CMR was discussed within disorder induces phase separation scenario and percolative metal insulator transition [2]. Here we try to get more reliable information on the CMR physics on epitaxial strain-free LPCMO films (single crystals are not available). We prepared LPCMO films on MgO(100) substrates by metalorganic aerosol deposition technique. The structure was studied by X-ray diffraction. Magnetization and resistivity were measured as a function of temperature, $T = 10 - 300K$, and magnetic field, $B = 0 - 7T$. With these data, we were able to create a phase diagram for LPCMO films and to observe hysteretic temperature and magnetic field behavior as well as the influence of cation ordering. Support by Deutsche Forschungsgemeinschaft via SFB 602, TP A2 is acknowledged.
[1] M. Uehara, S. Mori, C.H. Chen, S.-W. Cheong "Percolative phase separation underlies colossal magnetoresistance in mixed-valent manganites" Nature, 399:560, 1999
[2] Elbio Dagotto. "Nanoscale Phase Separation and Colossal Magnetoresistance" Spinger-Verlag, 2002

MA 19.2 Wed 15:30 H22

Optically induced electron conduction in Ce-doped lanthanum manganite films — •Andreas Thiessen[1], Elke Beyreuther[1], Stefan Grafström[1], Kathrin Dörr[2], and Lukas M. Eng[1] — [1]Institut für Angewandte Photophysik, Technische Universität Dresden, D-01062 Dresden — [2]Institut für Metallische Werkstoffe, IFW Dresden, D-01171 Dresden

The question whether electron-doped mixed-valence manganites, such as $La_{0.7}Ce_{0.3}MnO_3$, can be synthesized as single-phase compounds has been under debate for more than a decade. By now there is some agreement that it is possible to prepare high-quality single-phase material through epitaxial thin-film growth [1], but as-prepared films often suffer from overoxygenation and concomitant hole doping instead of the nominal and desired electron doping. Deoxygenation through post-deposition annealing in vacuum seems to solve this problem [2]. However, oxygen-reduced samples are insulating and do not exhibit a phase transition from a paramagnetic insulating to a ferromagnetic metallic phase any longer [3].

In the present work, we show that photoexcitation renders such thin films conductive and recovers the phase transition [3]. Possible mechanisms behind the pronounced photoconductivity effect are presented, especially the role of the $SrTiO_3$ substrate. Several indications that strongly point towards an electron-doped nature of the illuminated films are discussed. [1] Mitra et al., *J. Appl. Phys.* **89**, 524 (2001). [2] Beyreuther et al., *Phys. Rev. B* **73**, 155425 (2006). [3] Beyreuther et al., *Phys. Rev. B* **80**, 075106 (2009).

MA 19.3 Wed 15:45 H22

Switching on the Nanoscale on $La_{0.7}Ca_{0.3}MnO_3$ Thin Films — •Jon-Olaf Krisponeit, Christin Kalkert, Bernd Damaschke, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Perowskite manganites are known to show a variety of resistance effects, including not only temperature-driven metal to insulator transitions but also the colossal magneto resistive effect (CMR).

Here, we have examined a $La_{0.7}Ca_{0.3}MnO_3$ thin film prepared by the metalorganic aerosol deposition technique. The resistance behavior was studied not only macroscopically but also on the nanoscale. Topography and current images have been recorded with an atomic force microscope (AFM) using a tip with conductive coating. Local I-V-characteristics have been taken.

We observed repeatable switching of individual nano-scaled regions that is reversible by applying a voltage of the opposite polarity. Our results clearly show a threshold voltage as well as a dependance on pulse duration. The results are discussed in terms of oxygen drift versus local structural changes.

Acknowledgement: The work is supported by DFG via SFB 602, TP A2 and the Leibniz program.

MA 19.4 Wed 16:00 H22

Ultrafast optical and X-ray studies of multifunctional oxide multilayers — •Marc Herzog[1], Wolfram Leitenberger[1], Roman Shayduk[2], and Matias Bargheer[1] — [1]Universität Potsdam, Institut für Physik und Astronomie — [2]Helmholtz-Zentrum Berlin für Materialien und Energie

We compare ultrafast optical and x-ray measurements on epitaxial multifunctional oxide multilayers possessing a perovskite crystal structure arranged in alternating layers of ferromagnetic (FM) metals and paraelectric/ferroelectric insulators. The FM oxides include $(La_{2/3}Sr_{1/3})MnO_3$ and $SrRuO_3$ while the non-metallic layers are built from $Pb(Zr_{0.2}Ti_{0.8})O_3$ and $SrTiO_3$. All-optical pump-probe experiments across the FM transition temperature are presented and optical pump - x-ray probe measurements at room temperature evidence the excitation of coherent acoustic phonon modes leading to drastic modulations of the X-ray diffraction patterns on a 1-ps time scale. These measurements allow for an accurate calibration of all-optical experiments regarding the amplitude of lattice motion.

MA 19.5 Wed 16:15 H22

Optical CMR in Manganites — •Markus Jungbauer, Sebastian Hühn, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen

Colossal magnetoresistance (CMR) and metal insulator transition in the perovskite manganites are still puzzling phenomena. We focussed on epitaxial films of $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ with $y = 0$–0.7, where a phase separation scenario with coexisting ferromagnetic metallic and charge-ordered insulating phases is believed to be the origin of the CMR.

Using reflectivity measurements, we observed changes in the optical conductivity with external magnetic field in the visible range. This optical CMR peaks at the metal insulator transition temperature T_{MI} as does the CMR. Furthermore the magnetic field behaviour resembles the field dependence of the resistance. Moreover optical CMR shows a pronounced spectral dependence for photon energies $E = 1.2 - 4\,eV$. This indicates that with optical CMR we probe the short range order of the Mn-Spins. Since this optical technique generates information on the volume of our samples, we get further insight to the CMR-effect, proving the percolative nature of phase transition by modelling the results within random resistor networks.

Support of the DFG via SFB 602 TP A2 is acknowledged.

MA 19.6 Wed 16:30 H22

Ultrasound velocity of CMR manganites at the phase transition — •Markus Michelmann, Walter Arnold, Vasily Moshnyaga, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37707 Göttingen

Perovskite (La, Pr, Ca)MnO_3 manganites attract great attention due to colossal magnetoresistance (CMR), strong electron-phonon-coupling and electronic phase-separation. Here we studied elastic properties of polycrystalline $(La_{1-y}Pr_y)_{0.7}Ca_{0.3}MnO_3$ bulk samples by means of ultrasound velocity measurement (at ∼5MHz) as a function of temperature ($T = 20 - 300$K) and magnetic field ($B = 0 - 5$T). The sound velocity drops near the M-I-transition by ∼3% in a single step but changes its shape with applied magnetic field ($B > 2$T). The results of the elastic properties look first like a CMR-behaviour indicating a significant structural modification. However, in higher fields the nature of the transition seems to vary. The results will be compared with specific heat and magnetization measurements for the same CMR compounds. Support by Deutsche Forschungsgemeinschaft via SFB 602, TP A2 is acknowledged.