MM 33: Topical Session Multifunctional Materials II

Time: Wednesday 12:00–13:00 Location: H6

Topical Talk MM 33.1 Wed 12:00 H6

Strain-dependent ferroic properties of doped $LaMO_3$ (M = Mn or Co) and $BiFeO_3$ — •Kathrin Dörr[1], Diana Rata[1], Andreas Herklotz[1], Orkidia Bilani[1], Martina Dekker[1], Ludwig Schultz[1], Marianne Reibold[2], Michael Biegalski[3], and Hans Christen[3] — [1]IFW Dresden, Postfach 270116, 01171 Dresden, Germany — [2]Technische Universität Dresden, Speziallabor Triebenberg, 01328 Dresden, Germany — [3]Oak Ridge National Laboratory, CNMS, PO Box 2008, Bethel Valley Rd.,Oak Ridge, TN 37831, USA

Elastic strain at epitaxially grown interfaces provides an efficient coupling mechanism in two-phase multiferroics: piezoelectric or magnetostrictive strain arising from application of an electric or a magnetic field is transferred readily between the components. We employ a piezoelectric single-crystalline substrate to apply reversible biaxial strain to epitaxially grown magnetic or ferroelectric films and study the strain response of their ferroic properties. The relaxor-based $0.72PbMg_{1/3}Nb_{2/3}O_3$ -$0.28PbTiO_3$(001) (PMN-PT) proved to be a favourable piezo-substrate with large, reversible, uniform in-plane strain which shows little temperature dependence. The magnetization vs. strain of doped $LaMO_3$ (M = Mn or Co) phases has been studied. It reveals the impact of the strain-induced tetragonal lattice distortion on the ferromagnetic double exchange and the magnetic moment of Co ions that leads to moderate or large magnetization modulation. Further, the strain dependence of ferroelectric switching has been investigated for multiferroic $BiFeO_3$. It displays a large response of unexpected sign attributed to a strain influence on kinetics.

MM 33.2 Wed 12:30 H6

Riesen-magnetoelektrischer Effekt in dünnen FeCoBSi-AlN Kompositfilmen — •Henry Greve[1], Eric Woltermann[1], Hans-Joachim Quenzer[2], Bernhard Wagner[2] und Eckhard Quandt[1] — [1]Anorganische Funktionsmaterialien, Institut für Materialwissenschaft der Christian-Albrechts-Universität zu Kiel, Kaiserstr. 2, 24143 Kiel — [2]Mikrosystemtechnik, Fraunhofer Institut für Siliziumtechnologie ISIT, Fraunhoferstr. 1, 25524 Itzehoe

Magnetoelektrische (ME) Kompositmaterialien, bestehend aus einer piezoelektrischen und einer magnetostriktiven Phase, haben in letzter Zeit immer mehr an Beachtung gewonnen, da sie um mehrere Größenordnungen höhere ME Koeffizienten aufweisen können als einphasige Materialien. Solche riesen-magnetoelektrischen Komposite sind viel versprechend für Anwendungen wie z.B. hochempfindliche Magnetfeldsensoren. 2-2 Dünnschichtkomposite, bestehend aus AlN und amorphen $Fe_{57}Co_{18}B_{14}Si_1$ Lagen, wurden mittels Magnetronsputtern auf Si (100) Biegebalken abgeschieden. Nach thermischem Auslagern in einem externen Magnetfeld weisen die Komposite einen extrem hohen, direkten ME Koeffizienten von 737 V/cmOe bei der mechanischen Resonanz des Biegeelements von 753 Hz auf. Außerhalb der Resonanz bei 100 Hz beträgt der ME-Koeffizient 3,1 V/cmOe. Dies sind die höchsten bisher erreichten ME Koeffizienten für Dünnschichtkomposite. In Kombination mit der durch Magnetfeldglühung und Formanistropie erzielten magnetischen Anisotropie machen diese einzigartigen Eigenschaften die ME Schichten zu höchst attraktiven Kandidaten für MEMS (Mikroelektromechanische Systeme) basierende Vektorfeldsensoren.

MM 33.3 Wed 12:45 H6

Strain-dependent magnetism of $La_{0.8}Sr_{0.2}CoO_3$ — •Andreas Herklotz[1], Mike Biegalski[2], Hans Christen[2], Ludwig Schultz[1], and Kathrin Dörr[1] — [1]IFW Dresden, Germany — [2]CNMS, ORNL, USA

Perovskite transition-metal oxides have attracted much attention because of the possibility of tuning the magnetic and electronic properties of thin films through interface effects such as exchange interactions, charge transfer, and epitaxial strain.

We investigate the strain-dependence of epitaxial LSCO ($La_{0.8}Sr_{0.2}CoO_3$) thin films in two ways. First, we grow LSCO in different strain states on PMN-PT(001) ($0.72PbMg_{1/3}Nb_{2/3}O_3$-$0.28PbTiO_3$) substrates. Compositionally controlled LASO ($LaAl_{1-x}Sc_xO_3$) buffer layer serve to allow for a tunable lattice strain not affected by the underlying substrate. Second, we use the ferroelectric PMN-PT substrates to biaxial compress as-grown films reversibly by more than 0.1%.

Our experiments show that biaxial strain suppresses ferromagnetism. We have recorded a decrease in the average Co magnetic moment and the transition temperature with increasing tensile strain from as grown films. The dynamic strain experiments help to gain further insight into phase-separated cobaltites and indicate a domination of the double exchange. A considerable change of the Co spin state cannot be observed.