

P.11.11.7*Acta Cryst.* (2005). A61, C397**Synthesis, Nuclear structure, and Magnetic Properties of Some Doped Perovskites**Roland Tellgren, Mehreteab Tseggai, Per Nordblad, *The Angstrom Laboratory, Uppsala University, Box 531, SE-751 21 Uppsala, Sweden.* E-mail: rte@mkem.uu.se

The compositions and purity of polycrystalline powder samples of $\text{Nd}_{0.7}\text{Sr}_{0.3}\text{Mn}_{1-x}\text{Mg}_x\text{O}_3$ ($x = 0.0, 0.1, 0.2, 0.3$), $\text{LaCr}_{1-x}\text{Mn}_x\text{O}_3$ ($x = 0.0, 0.1, 0.2, 0.3$) and $\text{La}_{1-x}\text{Nd}_x\text{Cr}_{0.5}\text{Mn}_{0.5}\text{O}_3$ ($x = 0.0, 0.15, 0.2$) were characterized by X-ray diffraction and chemical analysis. The magnetic properties were investigated by neutron powder diffraction technique and magnetization measurement using a SQUID.

All the structures studied have orthorhombic structure, space group Pnma, in a wide range of temperatures. The Mg-substitution in $\text{Nd}_{0.7}\text{Sr}_{0.3}\text{Mn}_{1-x}\text{Mg}_x\text{O}_3$ creates only small distortions in the nuclear structure. The magnetic properties of the compounds, however, are significantly affected by Mg- substitution.

All the samples of nominal composition $\text{LaCr}_{1-x}\text{Mn}_x\text{O}_3$ have orthorhombic structure with space group Pnma at temperatures between 1.5 and 400 K. However, at 600 K, all samples are found to have rhombohedral structure with space group R-3c. The magnetic properties of the system are markedly affected by Mn-substitution. The parent compound, LaCrO_3 , is purely G-type antiferromagnetic with Neel temperature at about 300 K. With increasing Mn-substitution, gradually, a ferromagnetic component develops in the system, thereby leading to the occurrence of canted magnetic moment.

The magnetic structure of $\text{La}_{1-x}\text{Nd}_x\text{Cr}_{0.5}\text{Mn}_{0.5}\text{O}_3$ is antiferromagnetic, G-type, from room temperature down to 10 K. A small ferromagnetic component appears at the lowest temperatures.

Keywords: magnetic perovskites, antiferromagnetic, superexchange

P.11.11.8*Acta Cryst.* (2005). A61, C397**On the Initial Stage of Plastic Deformation of SrTiO₃**Peter Paufler, André Belger, Beate Bergk, Dirk C. Meyer, Alexander Levin, *Chair of Crystallography, Institute of Structural Physics, Dresden University of Technology, D-01062 Dresden, Germany.* E-mail: paufler@physik.tu-dresden.de

Nanoindentation experiments have been performed on {100}-, {110}- and {111}- oriented single crystals at room temperature. Force-displacement curves $F(h)$ showed pop-ins at $F > 500\mu\text{N}$. Their depth Δh varied between $\Delta h = 1 \dots 20$ (for {100} and {110}) or $= 5 \dots 40$ nm (for {111}). They indicate the onset of plastic deformation and correspond to extreme strain rates of 20s^{-1} . Connected with pop-ins, slip bands starting from the indent have been observed which are parallel to macroscopically active zones of slip planes {011} or {100}. They are also compatible with the slip direction $\langle 0-11 \rangle$ (cf. [1]). These bands propagate proportionally to both the depth of the indent and the contact pressure beneath the indenter. Extrapolating $\Delta h(\sigma) \rightarrow \Delta h = 0$ gives the following critical contact pressures p_c , when plastic deformation should set-in during increase of load. We found $p_c/\text{GPa} = 19.0$ (100), 20.0 (110), 23.00 (111) GPa for the three surface orientations (hkl), which are of the order of $E/10$. This stress level and the energy associated with a pop-in let us assume that spontaneous generation of dislocations occurs during a pop-in. Unlike macroscopic plastic deformation, which starts at a flow stress of 0.15 GPa [1], nanoindentation probes only part of the crystal $< d^3$ where no grown-in dislocations (average spacing d) will be encountered, hence stresses higher at 2 orders of magnitude are required.

[1] Brunner D., Taeri-Baghadrani S., Sigle W., Rühle M., *J. Am. Ceram. Soc.*, 2001, **84**, 1161

Keywords: nanohardness, plastic deformation, dislocations

P.11.11.9*Acta Cryst.* (2005). A61, C397**Nano-Structure of PLD-Grown Epitaxial PbTiO₃/BaTiO₃ Superlattices by Synchrotron X-ray Diffraction**Eric Dooryhée^a, Maud Nemoz^a, Jean-Louis Hodeau^a, Françoise Le Marrec^b, Nathalie Lemée^b, Michael Karkut^b, ^a*Lab. Cristallographie, CNRS, 25 av. des Martyrs, BP166, 38042 Grenoble, France.* ^b*Lab. de Physique de la Matière Condensée, 33 rue St-Leu, 80039 Amiens, France.* E-mail: eric.dooryhee@grenoble.cnrs.fr

By combining different ferroelectric layers, such as PbTiO_3 (PTO), BaTiO_3 (BTO) into artificially modulated structures, it is possible to investigate the role that size and interface play in the ferroelectric phase transition, the ferroelectric coupling across dielectric layers, the effects of strain on the ferroelectric properties. The physical behaviour of such compounds is primarily by their epitaxial crystalline quality, their composition and their structural perfection. We have extended a diffraction model⁽¹⁾, previously applied on metallic and semiconductor multilayers, to the more complex case of $(\text{PTO}/\text{BTO})_n$ perovskite superlattices. The entire (001) diffraction profiles of the $(\text{BaTiO}_3/\text{PbTiO}_3)_n$ superlattices are fitted over 8 orders of diffraction ($L=1$ to 8). We evaluate the coherence length, the interface roughness, the discrete thickness fluctuations, and the intra-layer gradients of strain and atomic diffusion in the $\langle 001 \rangle$ growth direction.

Probing the reciprocal space along $\langle 100 \rangle$ and $\langle 010 \rangle$ shows the distribution and orientations of coherent domains and their respective unit cell dimensions parallel to the growth plane. Our diffraction measurements support the presence of $\{a\}$ domains, i.e. the polar axis of PbTiO_3 is parallel to the surface, as a result of large lattice relaxation.

[1] Fullerton et al., *Phys. Rev.*, 1992, **B45**, 9292.

Keywords: multilayers, perovskite oxides, BaTiO₃/PbTiO₃

P.11.11.10*Acta Cryst.* (2005). A61, C397**Tolerance Factors and Solid Solutions in Three-Layer Aurivillius Ceramics**Scott T. Mixture, S.A. Speakman, E. Henriques, H-J Kim, *New York State College of Ceramics at Alfred University, 2 Pine St., Alfred, NY 14802, USA.* E-mail: mixture@alfred.edu

The Aurivillius phases are of interest in ferroelectric random access memory devices. We present first a range of solid solubility data for isovalent and aliovalent doping in the 3-layer Aurivillius phases that were prepared using solid state and polymerized complex methods. A range of approximately 100 compositions were investigated, and many were evaluated using electrical conductivity measurements to determine the total conductivity and type of charge carriers.

Early reports of tolerance factors, similar to those developed by Goldschmidt for perovskites, have been revisited by considering strain between the structural layers and the total oxygen concentration. Neutron diffraction results that include bond valence sum calculations show that the static disorder that is often observed in the Aurivillius phases in the form of site mixing between the large cation in the perovskite block and Bi in the $[\text{Bi}_2\text{O}_2]^{2+}$ layer. The interlayer strains evidenced from the calculations are supported by the experimental results. Finally, the model is used to show that the average oxidation state of cations that can take mixed valence, for example the transition metals, is a function of the strains imposed by the layered structure.

Keywords: Perovskite structures, structural stability, ferroelectrics

P.11.11.11*Acta Cryst.* (2005). A61, C397-C398**Tensor Properties of Engineered Domain Configurations in KNbO₃ Crystals**Jiří Fuksa, *Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic.* E-mail: fuksa@fzu.cz

Using a general method [1], [2], recently implemented in [3], we determine possible macroscopic types of engineered domain configurations of the $Amm2$ -phase in potassium niobate crystals. We find that among 17 types of the domain configurations that can be, theoret-