Magneto-ferroelectric properties of the hexagonal Manganites

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The hexagonal $RMnO_3$ exhibit much higher magnetic and ferroelectric ordering temperatures, T_N = 75 K and T_{FE} = 930 K than the orthorhombic $RMnO_3$ with an incommensurate antiferromagnetic ordering below 40K. However, the coupling between the magnetic and electric order is very weak[1]. We have investigated the origin of the electric order by high temperature x-ray diffraction using high energy synchrotron radiation. We discuss the change in symmetry at the ferro-electric ordering temperature, which is a few hundred degrees below the tripling of the unit cell. We show that the hexagonal manganites are proper ferroelectrics in contrast with what has been reported until now[2]. Additionally, we have used magneto-capacitance measurements to study the coupling between the magnetic and electric order. We report large enhancements of the coupling by Ga substitutions in hexagonal $RMnO_3$ [3].

[1] *The origin of ferroelectricity in magnetoelectric $YMnO_3$*,
B. van Aken, T.T.M. Palstra, A. Filippetti, N. Hill, Nature Materials **3**, 164 (2004).

[2] *Symmetry changes at the ferroelectric transition in multiferroic $YMnO_3$*,
G.. Nénert, Y. Ren, H. Stokes, T.T.M. Palstra, submitted.

[3] *Tuning of the magneto-ferroelectric coupling in $Y(Mn,Ga)O_3$*,
A. Nogroho, T.T.M. Palstra, to be submitted