

University of Groningen

Proper ferroelectric transition in the multiferroic YMnO₃

Néner, Gwilherm; Ren, Yang; Pollet, Michael; Hauback, Björn; Moreira, Ibério P.R. de; Marinel, Sylvain; Stokes, Harold T.; Palstra, Thomas T.M.

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2006

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Néner, G., Ren, Y., Pollet, M., Hauback, B., Moreira, I. P. R. D., Marinel, S., Stokes, H. T., & Palstra, T. T. M., (2006). *Proper ferroelectric transition in the multiferroic YMnO₃*, 1 p.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

m46.o03

Relaxor behaviour in the system (1-x) Ba_{1-x}Bi_{2x/3}TiO₃ + x Ba_{1-y}Y_{2y/3}TiO₃

K. Taïbi*, C. Abdellaoui*, A. Guehria-Laidoudi*,
A. Simon** and J. Ravez**

* Faculté de Chimie, U.S.T.H.B., BP 32 El-Alia, Bab-Ezzouar, Alger, Algeria. ** I.C.M.C.B.-C.N.R.S., 87 avenue du D' A. Schweitzer, 33608 Pessac, France. E-mail: taibikamelz@yahoo.fr

Keywords: lead-free, ferroelectric relaxor, perovskites

Relaxor ferroelectrics are used for applications in a wide variety of devices [1]. The great interest of these materials is related to their very high dielectric permittivity observed in the large range of temperature and the strong frequency dispersion at low temperature [2]. To understand the origin of this behaviour many works based on structural and physical models are performed. The relaxor behaviour occurs generally in complex perovskite of formula (A'A')(B'B'')O₃ where two (or more) cations of different valences are located in the equivalent crystallographic positions. Relaxor materials actually used are lead-based ceramics which present a disadvantage due to the toxicity of PbO. The actual evolution of research is oriented to environment-friendly application. In this way, the present work concerns new lead-free compositions of non-stoichiometric perovskite derived from the well known BaTiO₃.

Dense ceramics were obtained by conventional mixed oxide method. Room temperature X-ray diffraction analysis allowed us to determine the limits of solid solution. Dielectric measurements were performed on ceramic disks. For all samples, the temperature and frequency variations of the real and imaginary part of permittivity are investigated. The results are discussed and compared to previous works concerning the Ba_{1-x}A_{2x/3}TiO₃ compositions where La and Bi are in the dodecahedral sites (A) [3,4]. The performed study has shown that the relaxor behaviour is not due only to the B-site order/disorder. The role of the cation in the A-site seems to be also important [5].

[1] K. Uchino, *Ferroelectrics*, 151(1994) 321.

[2] L.E Cross, *Ferroelectrics*, 151, (1994) 305.

[3] J. Ravez and A. Simon, *Solid State Science*, 2 (2000) 525.

[4] F. Bahri, A. Simon, H. Khemakhem and J. Ravez, *Phys.Stat.Sol.*, 184,2 (2001) 459.

[5] A. Kerfah, K. Taïbi, A. Guehria-Laïdoudi, A. Simon and J. Ravez, *Solid State Sciences*, accepted, September, (2005).

m46.o04

Proper ferroelectric transition in the multiferroic YMnO₃

Gwilherm Nénert¹, Yang Ren², Michael Pollet³,
Björn Hauback⁴, Ibério P.R. de Moreira⁵, Sylvain Marinel⁶,
Harold T. Stokes⁷, Thomas T.M. Palstra¹

¹Solid State Chemistry Laboratory, Materials Science Centre, University of Groningen, Nijenborg 4, 9747 AG Groningen, The Netherlands, ²X-ray Science Division, Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois 60439, USA, ³ICMCB - CNRS Physico-Chimie des Oxydes Conducteurs, 87 Avenue du Docteur Schweitzer 33608 Pessac Cedex France, ⁴Physics Department, Institute for Energy Technology, P. O. Box 40 2027 Kjeller, Norway ⁵Departament de Química Física and CeRQT, Universitat de Barcelona, Martí Franquès 1, 08028 Barcelona, Spain, ⁶CRISMAT - ENSI Bd Maréchal Juin - 14050 Caen Cedex; France, ⁷Department of Physics and Astronomy, Brigham Young University, Provo, Utah 84602-4650, USA

Keywords: multiferroic, ferroelectrics, phase transitions

Compounds presenting coexistence of ferroelectricity and magnetism have interesting properties allowing the manipulation of electric and magnetic moments by magnetic and electric fields, respectively. These compounds are called multiferroics. While a lot of effort has been put into the search and design of new multiferroics, the nature of the mechanism of ferroelectricity and thus the nature of the coupling between the different degrees of freedom is still not well understood [1]. Among the multiferroics, the hexagonal (h-) RMnO₃ are particularly interesting due to the high polarization at room temperature (P_S~5.5 C/cm²). The h-RMnO₃ exhibit T_{FE}~1000 K and T_N~100 K. We have studied above room temperature the parent compound YMnO₃ of h-RMnO₃ family. We observed for the first time using single-crystal high resolution synchrotron data, powder neutron diffraction, and dilatometry two phase transitions in YMnO₃ associated with the ferroelectric transition and a tripling of the unit cell [2,3]. Using a complete group theoretical analysis and structure calculations, we identify the transition from a centrosymmetric to a ferroelectric state for the hexagonal RMnO₃ as the succession of two paraelectric phases namely P₆/mmc (high temperature) and P₆/mcm (intermediate temperature) and one ferroelectric phase with P₆cm symmetry (room temperature) [2,4]. We prove that this family of compounds is not improper ferroelectrics but proper ferroelectrics in agreement with the magnitude of the polarization. The polarization can be described by a correlated zigzag tilting of the MnO₅ polyhedra due to the displacements of the apical oxygens instead of the basal plane oxygens.

[1] J.Wang, *et al.*, *Science* 299, 1719 (2003); T. Kimura *et al.*, *Nature* 426, 55 (2003) and N. Hur *et al.*, *Nature* 429, 392 (2004).

[2] G. Nénert, Y. Ren, B. Hauback, H. T. Stokes, I. de P. R. Moreira, S. Siefert and T. T. Palstra, submitted to *Phys. Rev. B.*, cond-mat/0504546.

[3] G. Nénert, M. Pollet, S. Marinel, Y. Ren, A. Meetsma and Thomas T. M. Palstra, submitted to *Phys. Rev. B*, cond-mat/0601547.

[4] G. Nénert, H. T. Stokes, J. Pérez-Mato and T. T. M. Palstra, in preparation.