MAGNETOELASTIC COUPLING IN $CaMn_7O_{12}$

W. Sławiński [1*], R. Przeniosło [1], I. Sosnowska [1], and M. Bieringer [2]

[1] Institute of Experimental Physics, University of Warsaw, 69 Hoża Str., 00-681 Warsaw, Poland
[2] Department of Chemistry, University of Manitoba, Winnipeg, R3T 2N2, Canada

Keywords: perovskites, manganites, atomic position modulation, magnetic moments modulation, magnetoelastic coupling

**) e-mail: wojciech.slawinski@fuw.edu.pl*

The mixed manganese oxide $CaMn_7O_{12}$ is a multiferroic material [1] with a distorted perovskite structure [2]. The crystal structure [3] and the magnetic ordering [4] of $CaMn_7O_{12}$ have been studied by using high resolution SR diffraction and high resolution neutron diffraction. These diffraction studies show a modulation of the atomic positions in $CaMn_7O_{12}$ at temperatures below 250 K and magnetic structure modulation below T_N = 90 K [5,6].

The modulation of atomic positions has been described by using a quantitative model with a propagation vector $(0,0,q_p)$ [5] which gives good agreement with the results of both SR and neutron diffraction studies [6]. The neutron diffraction studies of $CaMn_7O_{12}$ show a modulated magnetic ordering below the Néel temperature T_N = 90 K. The modulation of the magnetic structure is described with a propagation vector $(0,0,q_m)$. Both magnetic and positional modulations are coupled together. The modulation length of the atomic positions (L_p) and of the magnetic moment modulation length (L_m) fulfill the relation $L_m = 2\,L_p$ at temperatures between 50 K and the Néel temperature T_N. The relation between modulation lengths L_p and L_m as well as minimum and maximum of the lattice constant c clearly show the magnetoelastic coupling in $CaMn_7O_{12}$ [1]. Below 50 K, there is a magnetic phase transition which is associated with important changes of the magnetic modulation length and also with the increase of magnetoelectric coupling [1].

References

[1] M. Sánchez-Andújar, S. Yáñez-Vilar, N. Biskup, S. Castro-García, J. Mira, J. Rivas, M. Señarís-Rodríguez, "Magnetoelectric behaviour in the complex $CaMn_7O_{12}$ perovskite", *J. Magn. Magn. Mater.* **321** (2009) 1739–1742.

[2] B. Bochu, J.L. Buevoz, "Bond lengths in $[CaMn_3][Mn_4]O_{12}$ "A new Jahn–Teller distortion of Mn^{3+} octahedral", *Solid State Commun.* **36**(2) (1980) 133–138.

[3] W. Sławinski, R. Przeniosło, I. Sosnowska, M. Bieringer, I. Margiolaki, A.N. Fitch, E. Suard, "Phase coexistence in $CaCu_xMn_{7-x}O_{12}$ solid solutions", *J. Solid State Chem.* **179**(8) (2006) 2443–2451.

[4] R. Przeniosło, I. Sosnowska, D. Hohlwein, T. Hauß, I.O. Troyanchuk, "Magnetic ordering in the manganese perovskite $CaMn_7O_{12}$", *Solid State Commun.* **111**(12) (1999) 687–692.

[5] W. Sławiński, R. Przeniosło, I. Sosnowska, M. Bieringer, I. Margiolaki, E. Suard, "Modulation of atomic positions in $CaCu_xMn_{7-x}O_{12}$ ($x \leq 0.1$)", *Acta Crystallogr. B* **65** (2009) 535–542.

[6] W. Sławiński, R. Przeniosło, I. Sosnowska, M. Bieringer, "Structural and magnetic modulations in $CaCu_xMn_{7-x}O_{12}$" *„J. Phys.: Condens. Matt.* **22** (2010) 186001–6.