$Mn_3MnB'_2O_9$ high pressure *A*-site manganites with 1:2 B-site ordered triple perovskite structure

E. Solana-Madruga[1,2,3], C. Ritter[4], O. Mentré[2], Á. M. Arévalo-López[2]

[1] *Departamento de Química Inorgánica, Universidad Complutense de Madrid. Avda. Complutense sn, 28040, Madrid, España. elsolana@ucm.es*
[2] *CNRS, Université de Lille, Centrale Lille, ENSCL, Université d'Artois, UMR 8181- Unité de Catalyse et Chimie du Solide. Lille F-59000, France.*
[3] *CSEC and School of Chemistry, University of Edinburgh. Erskine Williamson Building, Peter Guthrie Tait Road, The King's Buildings. EH9 3FJ, Edinburgh, U.K.*
[4] *Institut Laue-Langevin. Avenue des Martyrs 71, Grenoble Cedex, France.*

ABO_3 oxides with perovskite related structures have largely been studied due to their chemical and physical versatility. Different types of cation order (1:1, 1:2 and 1:3) can be induced to enhance their physical properties. [1-3] The introduction of Mn into the *A* sites of the perovskite structure using high-pressure and high-temperature (HPHT) synthesis, provides a rich playground of potential spin, charge and orbital orderings. This throws attention to the growing family of functional A-site manganites, with non-ordered simple (Pv), 1:1 double (DPv, *A* or *B*) and doubly ordered (or double double DDPv, *A* and *B*) and 1:3 quadruple (QPv, *A*) perovskite structures. These compounds, with increasing chemical and structural complexity, show a wide range of promising physical properties as spintronics ($MnVO_3$ Pv), colossal magnetoresistance (Mn_2FeReO_6 DPv), crystal field induced magnetic anisotropy ($MnRMnSbO_6$ DDPv) and magneto orbital coupling ($MnMn_3Mn_4O_{12}$ QPv). [4-7]

A new family of 1:2 *B*-site ordered *A*-site manganites $Mn_3MnB'_2O_9$ (*B'* = Nb, Ta) with triple perovskite (TPv) structure (Fig. 1a) has recently been reported [8,9] to show a complex monoclinic distortion of the parent cubic Pv with *Cc* space group and $a = \sqrt{2}\sqrt{3}a_c$, $b = \sqrt{2}a_c$ and $c = 2\sqrt{3}a_c$ cell parameters Their complex magnetic behaviour includes three subsequent transitions where Mn^{2+} spins order into a collinear antiferromagnetic (AFM) structure, modulate in a complex spin density wave (SDW) with incommensurate [k_x 0 k_z] propagation vector continuously evolving with temperature and lock at low temperatures with k_L = [⅓ 0 -⅙] (Fig.1b). A high temperature phase transition for B' = Ta, allows to recover the room pressure multiferroic $Mn_4B'_2O_9$. A 25% band gap reduction between both phases is due to their different structural connectivity.

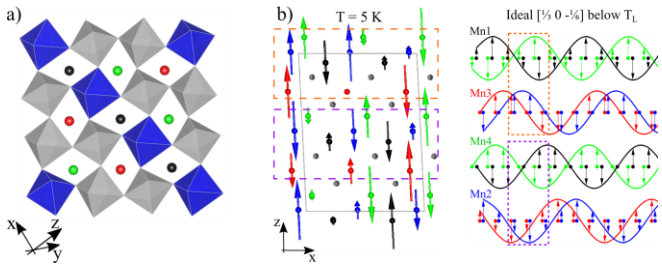

Fig.1. Crystal (a) and low temperature magnetic (b) structures of HP-$Mn_3MnNb_2O_9$ TPv.

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