Type of presentation: Oral

MS-12-O-2182 Atomically resolved EELS study of B-site ordering in a La_2CoMnO_6 thin film

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Double perovskites like a ferromagnetic insulating La_2CoMnO_6 have received considerable attention because of surprising multiferroic properties [1]. One of the most striking examples is that the local ordering of the Co/Mn cations plays an important role in the magnetic properties of this material. A ferromagnetic transition arises from the local interaction of the Co-O-Mn chains [2]. The absolute valence and spin states for Co and Mn in ordered and disordered phases are however not fully understood [3,4]. XAS experiments suggest that ordered phases involve Co^{2+} and Mn^{4+} states, whereas the disordered phase – Co^{3+} and Mn^{3+} [3]. We performed a complete atomic scale TEM characterization, including a detailed analysis in reciprocal space of the Bragg reflection corresponding to the Co/Mn ordering. A procedure was implemented to estimate the density of ordered and disordered regions in the La_2CoMnO_6 thin film grown on $SrTiO_3$(111) substrate by metalorganic aerosol deposition technique. Atomically resolved EDX maps directly show the ordered and disordered regions in accordance with EELS data from the same regions. The fine structure of the Co-$L_{2,3}$ and Mn-$L_{2,3}$ edges indicates subtle differences between ordered and disordered phases in good agreement with XAS experiments [3]. In the disordered phase the valence state is estimated to be a mixture of 2+ and 3+ for Co, and for Mn a mixture of 3+ and 4+ states, while in the ordered phase Co^{2+} and mainly Mn^{4+}. These local observations provide a better understanding of electronic interactions between Co and Mn and their importance for the ferromagnetic transition in double perovskites, like La_2CoMnO_6, and similar materials.

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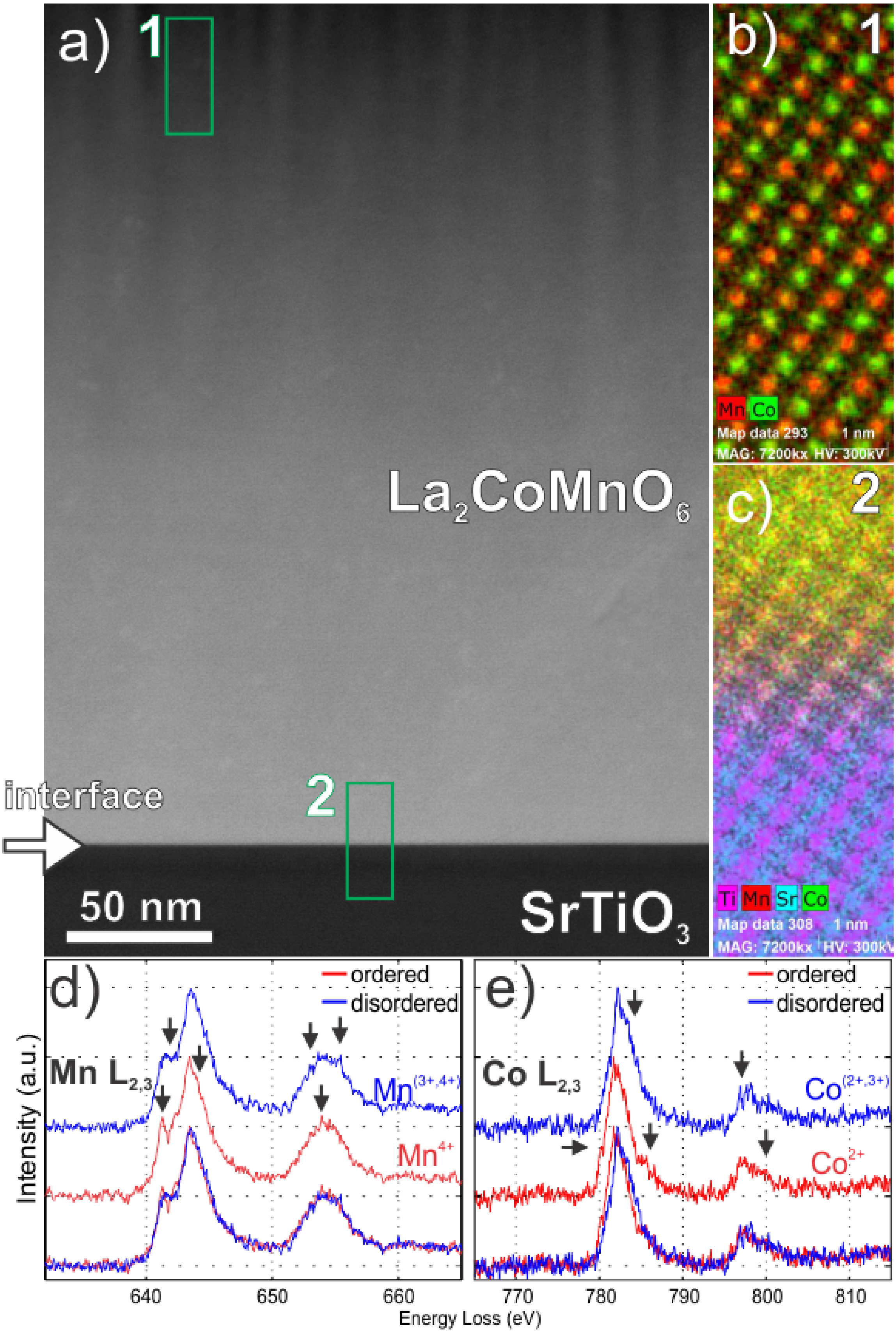

Fig. 1: Fig.1: (a) HAADF overview image and (b,c) atomically resolved EDX maps of two different regions in the La_2CoMnO_6 film, showing the Co/Mn distribution of the ordered (1) and disordered (2) phases. The EDX color maps demonstrate the cation ordering in a direct way. (d,e) ELNES of Mn and Co showing subtle differences related to valency changes.