

Nanoscale Ordering in Oxygen Deficient Quintuple Perovskite $\text{Sm}_{2-\epsilon}\text{Ba}_{3+\epsilon}\text{Fe}_5\text{O}_{15-\delta}$ revealed by advanced TEM.

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The investigation of the system Ln-Ba-Fe-O (Ln=Sm, Eu, Nd, Y) in air has allowed an oxygen deficient perovskite $\text{Ln}_{2-x}\text{Ba}_{3+x}\text{Fe}_5\text{O}_{15-\delta}$ to be synthesized. In contrast to the XRPD pattern which gives a cubic symmetry ($a_p = 3.934 \text{ \AA}$), the combined HRTEM/ED/STEM-HAADF/EELS study shows that this phase is nanoscale ordered. The electron diffraction (ED) study of this phase shows that whatever the crystallographic direction, [001], [010] or [100] a single a_p parameter in most of the cases cannot be observed, but instead superstructure spots, corresponding to an " $a_p \times a_p \times 5a_p$ " tetragonal cell are always identified.

The chemical ordering is clearly confirmed by HAADF-STEM and EELS mapping, which demonstrates that the Ln layers, spaced by $5a_p$ along the c axis, are practically pure and that the surrounding Ba layers are in fact not totally Ln free, but intermixed with a small amount of Ln. The nanodomains exhibit a unique stacking sequence of the A-site cationic layers, namely « Ln-Ba-Ln/Ba-Ln/Ba-Ba-Ln », and are chemically twinned in the three crystallographic directions. The nanoscale ordering of this perovskite explains its peculiar magnetic properties on the basis of antiferromagnetic interaction with spin blockade at the boundary between nanodomains. The variation of electrical conductivity and oxygen content of this oxide versus temperature suggest potential SOFC application.