# MODERN DEVELOPMENT OF MAGNETIC RESONANCE

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ABSTRACTS OF THE
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# Iron Oxidation State in $La_{0.7}Sr_{1.3}Fe_{0.7}Ti_{0.3}O_4$ and $La_{0.5}Sr_{1.5}Fe_{0.5}Ti_{0.5}O_4$ Layered Perovskites

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Layered perovskite structures with the chemical formula $A2BO_4$, (where A is a rare earth or alkaline earth element, and B is d-metals of the IV period of the periodic table), are widely known and intensively studied, since they possess a multifunctional set of properties that are promising for practical applications. In the $A_2BO_4$ structure, the $ABO_3$ layers with the perovskite structure are separated by A-O layers of rock salt, and the B-O-B electronic interactions can occur only in the plane. Variations in electrical, magnetic, catalytic, and other properties are possible both by isomorphic substitution of cations in the B positions, and by conjugate substitution in the B and A positions.

The investigated here $Sr_{2-x}La_xTi_{1-x}Fe_xO4$ ($x$ = 0.5 and 0.7) are materials with a high dielectric constant $\varepsilon \approx 10^5$ [1]. One of the reasons for the high values of the dielectric constant of these oxides was the small polaron hopping conduction mechanism presumably due to the different valence state of Fe that requires a detailed investigation of their magnetic properties. So the magnetometry, electron spin resonance and Mossbauer spectroscopy measurements of $La_xSr_{2-x}Fe_xTi_{1-x}O_4$ ($x$ = 0.5 и 0.7) oxides were performed to prove the existence of mixed-valence iron ions and study the associated effects [2].

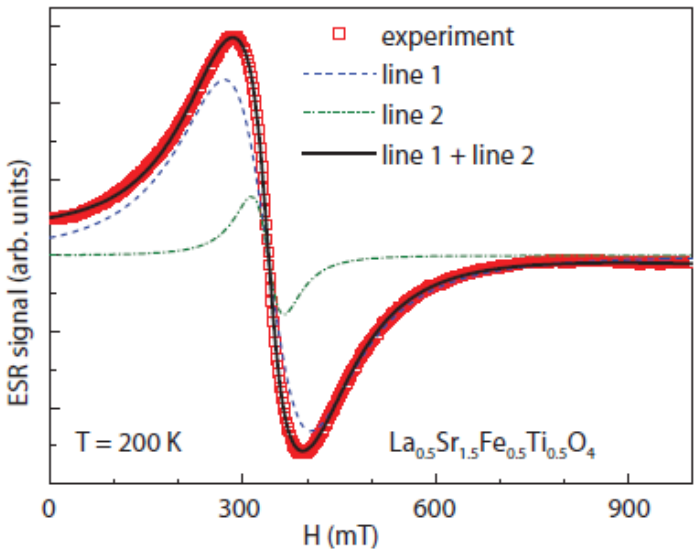


**Fig. 1.** Decomposition of the ESR spectrum of $La_{0.5}Sr_{1.5}Fe_{0.5}Ti_{0.5}O_4$ at $T$ = 200 K in X-band.

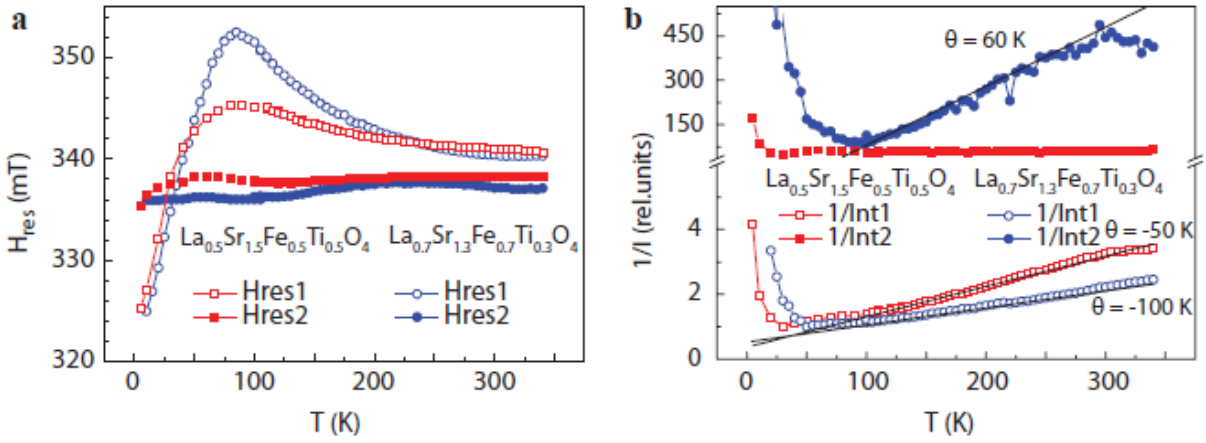


**Fig. 2.** Temperature dependence of (**a**) resonance field, (**b**) inverse normalized integral intensity $I^{-1}$ of two lines in ESR spectra of $La_{0.5}Sr_{1.5}Fe_{0.5}Ti_{0.5}O_4$ and $La_{0.7}Sr_{1.3}Fe_{0.7}Ti_{0.3}O_4$.

Based on our magnetization and electron spin resonance measurements it was suggested the presence of the electronic phase separation in the investigated samples – the simultaneous existence of the paramagnetic phase and magnetically correlated regions. Two types of signals in ESR spectra were clearly detected (Fig. 1): from paramagnetic phase – line 1 and from magnetically correlated regions – line 2. One can see from Fig. 2 that the integral intensity of the ESR signal from the paramagnetic phase (line 1) is two orders of magnitude higher than from magnetically correlated phase (line 2) assuming that samples are in a paramagnetic phase with a small inclusion of magnetically correlated regions.

Detailed investigations of obtained experimental data showed that the significant proportion of samples volume is a paramagnetic phase which is ordered antiferromagnetically at the phase transition temperature, while the second phase is ferromagnetically correlated regions in $La_{0.5}Sr_{1.5}Fe_{0.5}Ti_{0.5}O_4$ and canted ferrimagnetically correlated regions in $La_{0.7}Sr_{1.3}Fe_{0.7}Ti_{0.3}O_4$. The electronic phase separation can be realized due to the mixed-valence iron ions that mean the presence of $Fe^{4+}$ ions in addition to trivalent iron ions and that was exactly confirmed by Mossbauer spectroscopy investigations [2].

1. Chupakhina T.I., Melnikova N.V., Kadyrova N.I. *et al.*: Journal of Solid State Chemistry **292**, 121687 (2020)
2. Gavrilova T.P., Yagfarova A.R., Deeva Yu.A. *et al.*: Journal of Physics and Chemistry of Solids **153**, 109994 (2021)