The role of phase separation in dynamics of charge system of half-doped manganites

V. Chabanenko[1], S. Vasiliev[1], A. Nabiałek[2], T. Tsvetkov[1], S. Dunaevsky[3], R. Minikaev[2], S. Piechota[2], H. Szymczak[2], Z. Kravchenko[1]

1) Institute for Physics and Engineering, NASU, 72 Ul. R. Luxemburg, 83114, Donetsk, Ukraine.
2) Institute of Physics, PAS, al. Lotników 32/46, O2-668 Warsaw, Poland
3) Petersburg Nuclear Physics Institute, 188300, Gatchina, Russia

Doped manganites are characterized by a strong interaction of the electron, lattice, and spin subsystems, resulting in diversified phase transitions and various types of ordering. Metal–insulator and structural transitions are observed as well as various types of magnetic, orbital, and charge orderings [1-3]. The interest in such materials has risen due to the dependence of the dielectric permittivity on the magnetic field [4]. The variation is maximal at around 270 K, little above the Curie temperature, T_C, and it reaches a value of 35% in H = 0.5 T. According to author's assumption, this phenomenon is due to the space-charge or interfacial polarization produced between the insulator and the metallic regions segregated intrinsically in the material above T_C.

In our experiments a sample of half-doped manganite $La_{0.5}Ca_{0.5}Mn_{0.94}Fe_{0.06}O_3$ was put into a capacitor and a complex admittance, $Y=G+iB$ (G - conductance, B – susceptance), of such system was studied in a wide range of temperatures (2 – 400 K) and magnetic fields (0 - 12 Tesla). The admittance was measured in a wide range of frequencies (20 – 2 10^7 Hz) using precision LCR meters. The magnetic field dependence of the conductance, $G(H)$, reveal pronounced peaks with the maxima corresponding to the beginning of the ferromagnetic transition. Two maxima are observed in the temperature dependence of the conductance $G(T)$.

These and other results are interpreted within a framework of a kinetic model taking into account the coexistence of ferromagnetic metal and antiferromagnetic dielectric domains as well as thermally activated transitions between these states.

[1] B. Raveau et al., J. Solid State Chem. 130 (1997) 162.
[2] F. Damay et al., Appl. Phys. Lett. 73 (1998) 3772.
[3] J.C. Loudon et al., Nature 420 (2002) 797.
[4] J. Rivas et al., Appl. Phys. Lett. 88 (2006) 242906.