The Effect of Pressure on the Electro-Magnetic Property of NiO

by Osamu FUKUNAGA, Shinroku SAITO, Shigeru MINOMURA

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Abstract

Nickel and cobalt oxides, whose 3d orbits are not filled in the free electron states, are considered to have metallic conductivities from the band theory. The fact, however, is that these stoichiometric compounds are insulators. Non-stoichiometric NiO and Li-doped NiO ($Li_x Ni_{1-x}O$) have the resistivities of the order of several ohm.cm. almost equal to that of VO, TiO etc., which show metallic conduction, but the temperature coefficient of the resistivities of the former are still negative and semiconductors in this sense.

In the present experiment, the electric conductivities of NiO and Li-doped NiO were measured at very high pressure and it was tried to explain the high pressure effect on the conductivity from the point of view of the hopping model. A Kennedy-type of a high pressure piston-cylinder apparatus and a simple squeezer with Bridgman-type anvils were used in the present experiment.

One example of the experimental results in $Li_xNi_{1-x}O$ in case of $x = 0.1$ is described below. As shown in Figs. 1, 2, 3, the electric conductivity decreased with increasing pressure at constant temperature. The pressure coefficient of the activation energy of the electric conductivity of $Li_{0.1}Ni_{0.9}O$ was estimated to be $\Delta V_{act.} = (\partial q/\partial p)T = -1.02 \sim 1.94 \times 10^{-6}$ eV/bar and $(\partial q/\partial p)T < 0$.

This means that at the time of hopping of a positive hole, the distance between Ni^{2+} and Ni^{3+} seems to be shorter than the relaxation of lattice, which makes it difficult to explain the mechanism of the electric conduction from the hopping model.