

substance: FeO (Fe_{1-x}O)

property: conductivity

conductivity

dependence on p_{O_2} : Fig. 1, temperature dependence in Fe_{0.91}O: Fig. 2, at high pressures: Fig. 3, resistivity near T_N : Fig. 4.

At high temperatures σ varies in a manner similar to the stoichiometry with p_{O_2} but there are differences in detail. At low temperatures there is disagreement in the literature (Fig. 2). Above 170 K $\sigma = 300 [\Omega^{-1} \text{ cm}^{-1}] \cdot \exp(-0.07(\text{eV})/kT)$. The optical conductivity at 300 K can be calculated from the plasmon frequency using the formula $\sigma_{\text{opt}}[\Omega^{-1} \text{ cm}^{-1}] = \pi e v_p^2 \epsilon(\infty) / 30$ and has the value $17.3 \Omega^{-1} \text{ cm}^{-1}$ [77P]. Below this, the data of [62T] show a fall off not reflected in the data of [74B1]. The latter show a sharp kink at 120 K, the activation energy doubling below this temperature to 0.14 eV. Below 100 K, the authors find a $T^{-1/4}$ law, suggesting random-range hopping.

conductivity in nearly stoichiometric FeO: Quite different behaviour has been observed in nearly stoichiometric samples of FeO [74B2, 74B3]. A resistivity anomaly is found near T_N (Fig. 4); in this region, the effective mass $m_n = 4 m_0$ and the mobility is $\approx 10 \text{ cm}^2/\text{V s}$, suggesting large polaron coupling instead of the hopping conduction apparently found in more defect samples.

References:

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- 74B1 Bowen, H. K., Adler, D., Aufer, B. H.: J. Solid State Chem. 12 (1975) 355.
- 74B2 Balberg, I.: Phys. Semicond. Proc. Int. Conf. 1974, 920.
- 74B3 Balberg, I., Alexander, S., Helman, J. S.: Phys. Rev. Lett. 33 (1974) 836.
- 74K Kawai, N., Nishiyawa, A.: Proc. 4th Int. Conf. High Press. Kyoto 1974, 324.
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Fig. 1.

Fe_{1-x}O . Electrical conductivity vs. oxygen partial pressure at various temperatures. Solid lines: fit to a complex defect model [70S].

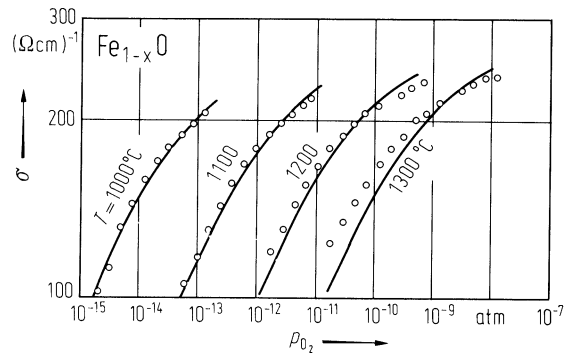


Fig. 2.

$\text{Fe}_{0.91}\text{O}$. Conductivity vs. reciprocal temperature. Heavy line: [74B1], thin line: [62T]. Fe_3O_4 for comparison.

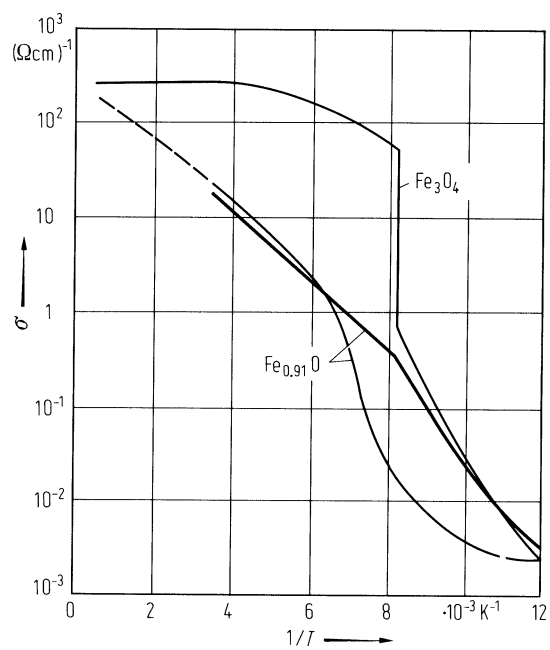


Fig. 3.

$\text{Fe}_{0.95}\text{O}$. Resistance vs. pressure [74K].

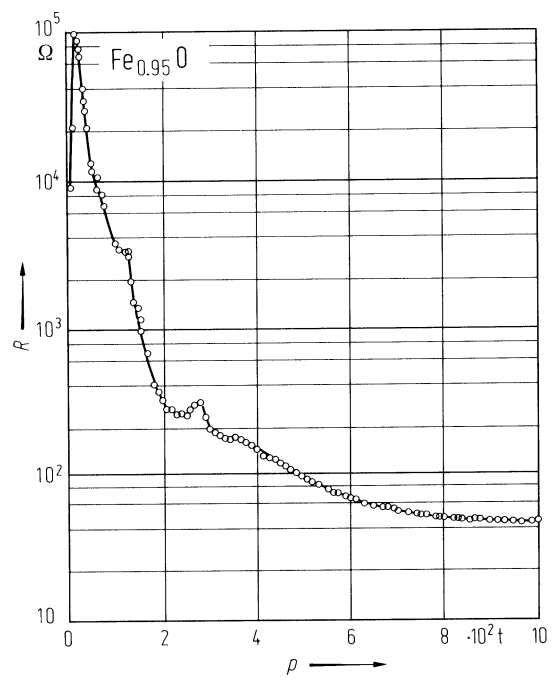


Fig. 4.

FeO. Resistivity vs. temperature near T_N . Solid line: experimental value; dotted line: calculated assuming no critical behaviour [74B2].

