

substance: Fe₃O₄

property: Seebeck coefficient

Seebeck coefficient: Figs. 1, 2. At lower temperatures the Seebeck coefficient has been interpreted in terms of a cation deficient model $\text{Fe}_{2+2\gamma}^{3+}\text{Fe}_{1-3\gamma}^{2+}(\text{V}_{\text{Fe}})_{\gamma}\text{O}_4$ with $E_A = 0.10\ldots 0.11$ eV and both n and p carriers, $(E_A)_p - (E_A)_n \approx 0.01$ eV, where E_A is the activation energy for drift mobility. Values of $(E_A)_n$ of ≈ 0.11 eV at $T = T_V$ and 0.04 eV at 80 K have been reported [76K]. The data of [76K, 71C, 79K] all show that at low temperatures, S is positive suggesting that below T_V , Fe_3O_4 is a p-type semiconductor.

At high temperatures ($T > T_C$) the Seebeck coefficient is well described by a diffusional (electron-hopping) model as $S = - (k/e) \ln [\beta(1-c)/c]$, where $\beta = 2$ is the spin-degeneracy and the concentration of mobile carriers, c , on the B sites is temperature dependent due to thermal excitations to the A sites [81W]. On lowering the temperature from $T > T_C$ to 300 K, the spin-degeneracy parameter decreases from $\beta = 2$ to $\beta = 1$ and correlated electron hopping changes the Seebeck coefficient to $S = - (k/e) \ln (1/c)$ [81S].

References:

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- 71C Constantin, C., Rosenberg, M.: Solid State Commun. 9 (1971) 675.
- 76K Kuipers, A. J. M., Brabers, V. A. M.: Phys. Rev. B14 (1976) 1401.
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- 81S Srinivasan, C., Srivastava, C. M.: Phys. Status Solidi (b) 103 (1981) 665.
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Fig. 1.

Fe_3O_4 . Seebeck coefficient vs. temperature for samples annealed under various oxygen pressures measured \parallel $[110]$. $\log p_{\text{O}_2} = (\text{A}) -4.2, (\text{B}) -9.0, (\text{C}) -9.7, (\text{D}) -9.9, (\text{F}) -10.2$; p_{O_2} in atm [76K].

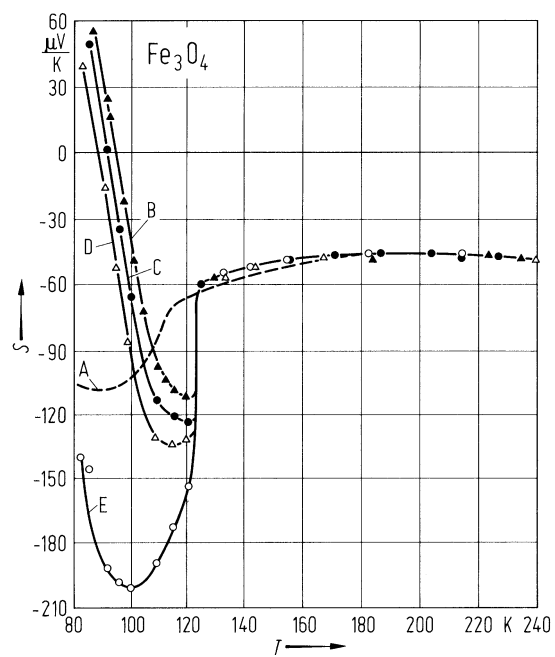


Fig. 2.

Fe_3O_4 . Resistivity (full circles [70G], triangles [52S]) and Seebeck coefficient (open circles) vs. temperature at high temperatures ($T > T_V$) [70G].

