substance: hematite (α-Fe_2O_3)
property: transport properties in doped Fe_2O_3

resistivity (first column) and activation energy (second column) for doped sinters at RT

ρ [Ω cm]:	$6.5\cdot10^5$	E_A [eV]:	0.728	undoped sample		74C
	$1.0\cdot10^0$		0.164	Tidoped,	1 at%	
	$5.1\cdot10^0$		0.191		0.1	
	$2.7\cdot10^3$		0.558		0.01	
	$4.0\cdot10^1$		0.207	Nb doped,	1 at %	
	$1.2\cdot10^2$		0,451		0.1	
	$1.0\cdot10^3$		0.602		0.01	
	$2.7\cdot10^7$		0.814	Cr doped,	1 at %	
	$5.9\cdot10^7$		0.814		0.1	
	$20.0\cdot10^7$		0.814		0.01	
	$1.2\cdot10^6$		0.722	Mn	1 at %	
	$6.3\cdot10^6$		0.722		0.1	
	$28.0\cdot10^6$		0.722		0.01	
	$3.9\cdot10^7$		0.809	V doped,	1 at %	
	$8.1\cdot10^7$		0.809		0.1	
	$25.0\cdot10^7$		0.809		0.01	

Ti doping: The Ti concentration and the carrier concentration determined from Seebeck data assuming the density of states in the valence band g_v = [Fe] and the kinetic term = 0 are very similar [54M]. Mobility found to be activated [54M] with a temperature dependent activation energy; at high T, E_A = 0.1 eV. Activation energy for conductivity is also a function of Ti concentration [65G]: Figs. 1, 2. Seebeck effect: Figs. 3; also [67D]. Electron drift mobility for ceramic sample 0.10(2) cm^2/V s at 1000 K. Hall coefficient: quite anomalous with $R_H > 0$, for $T \le T_N$. In the region 1000 K< T <1100 K, $\mu_H \approx 0.025$ cm^2/V s (ceramic sample) [67D].

Zr and Nb doping: Figs. 4, 5. From the exhaustion region, the drift mobility at 1200 K is 0.1 cm^2/V s for ceramic sample. Comparison of Seebeck and conductivity data (Fig. 6) shows that S and log ρ do not track, a result interpreted in terms of impurity conduction [70B]. Hall coefficient data have been interpreted in terms of spin-disorder scattering in a narrow band, with $m_n \approx 9.5\ m_0$.

Ca doping: conductivity: Fig. 7, Seebeck coefficient: Fig. 3, p-type behaviour.

Mg doping: conductivity: Fig. 8, Seebeck coefficient: Fig. 9, p-type behaviour. In the temperature range 450...900ºC, for Mg doped ceramic samples [66G] containing 0.2 at% Mg: $\mu_p \approx (262/T)\cdot \exp(-0.1[\text{eV}]/kT)$ [cm^2/V s] (T in K), a result completely at variance with the data for pure material. The Mg content cannot be increased beyond this level owing to spinel formation, $MgFe_2O_4$.

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Fig. 1.

Fe_2O_3:Ti. Conductivity vs. (reciprocal) temperature for Ti doped ceramic specimens in air and argon [65G]. For argon: p_{O_2} = equilibrium with Fe_2O_3 and Fe_3O_4. Short-dashed curve: pure Fe_2O_3 from [51M].

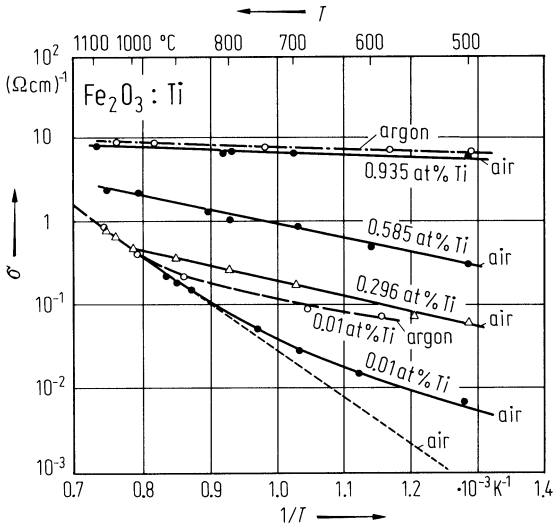

Fig. 2.

Fe_2O_3:Ti. Activation energy for conductivity vs. Ti doping concentration in the temperature range where n_d ([Ti]) is a constant [65G]. Ceramic sample.

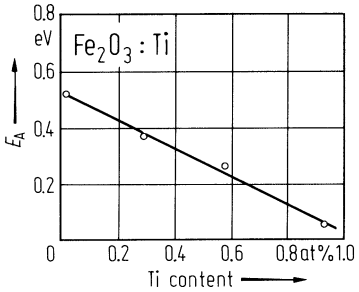

Fig. 3.

Fe_2O_3:Ti,Ca. Seebeck coefficient vs. temperature for Ti and Ca doped ceramic samples in air (open circles) and argon (full circles) ($p_{O_2} \approx 10^{-4}$ atm) (∗: data from [62T]) [65G].

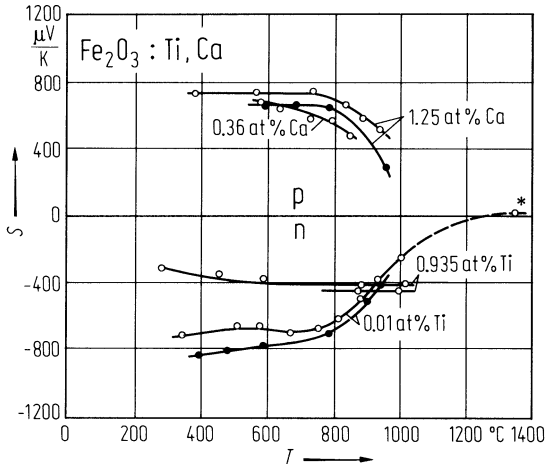

Fig. 4.

Fe_2O_3:Zr,Nb. Seebeck coefficient, resistivity and Hall coefficient vs. (reciprocal) temperature for ceramic α-Fe_2O_3. Open symbols in 0.01 atm O_2; filled symbols in 1 atm O_2. Samples doped as follows: (*1*) 0.01 at% Zr, (*2*) 0.1 at% Zr, (*3*) 0.12 at% Nb, (*4*) 0.25 at% Nb, (*5*) 1 at% Zr [67D].

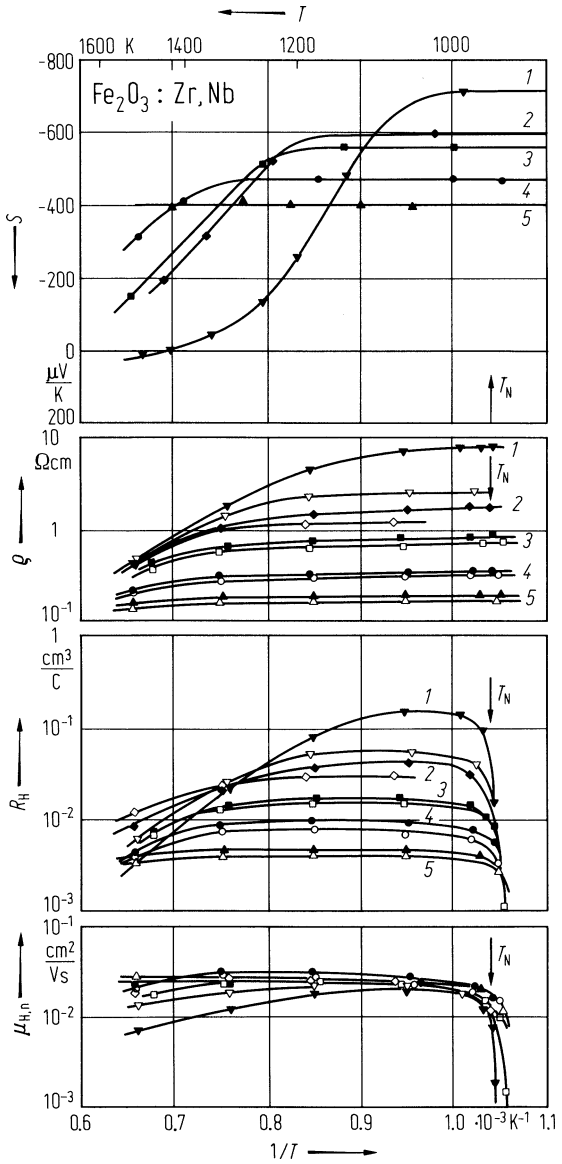

Fig. 5.

Fe_2O_3:Zr,Nb. Resistivity vs. (reciprocal) temperature for Zr and Nb doped ceramic samples. Open symbols: dc results, filled symbols; ac results. Zr doped samples: (*1*) 0.01 at%, (*2*) 0.1 at%, (*3*) 0.25 at%, (*4*) 1.0 at%, Nb doped samples: (*I,I'*) 0.1 at%, (*II*) 0.25 at%, (*III*) 0.5 at% [70B].

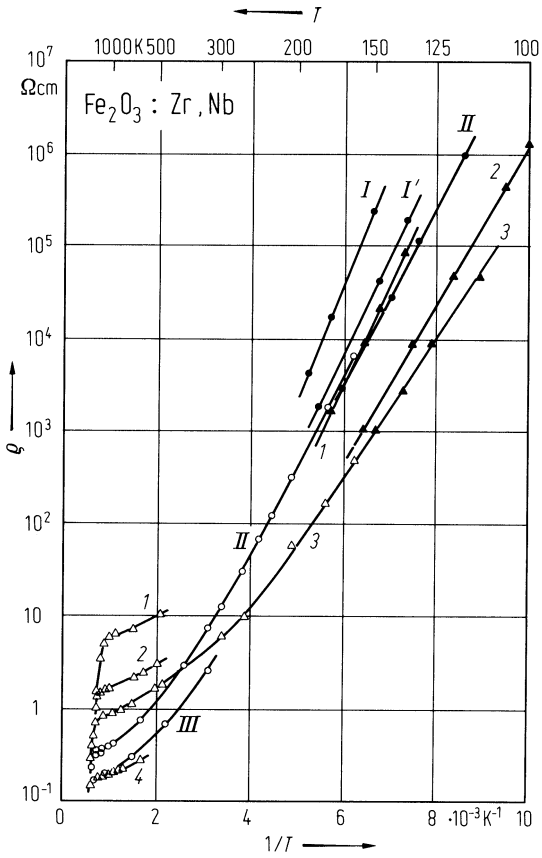

Fig. 6.

Fe_2O_3:Nb. Resistivity and reduced Seebeck coefficient vs. (reciprocal) temperature for 0.1 at% Li doped p-type NiO, p-type CoO and p-type MnO and 0.1 at% Nb doped n-type Fe_2O_3 [70B]. Ceramic samples.

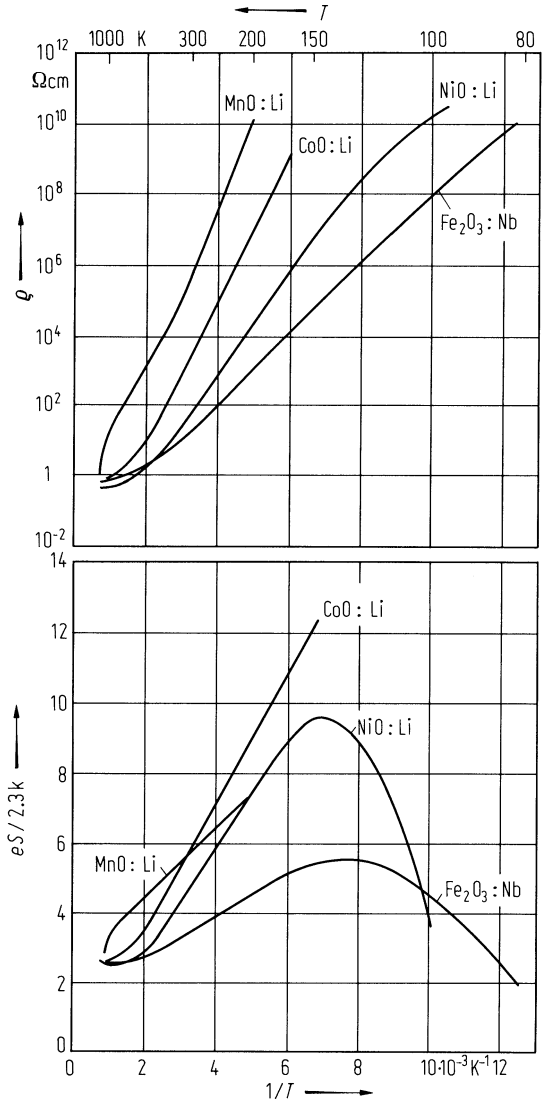

Fig. 7.

Fe_2O_3:Ti,Ca. Conductivity vs. (reciprocal) temperature for 0.01 at% Ti doped Fe_2O_3 (open circles), 0.30 at% Ca doped Fe_2O_3 (full circles), in air (solid line), in argon (dashed line) (p_{O_2} in equilibrium with Fe_2O_3 and Fe_3O_4); *I*: data from [51M] on pure Fe_2O_3. [65G]. Ceramic samples.

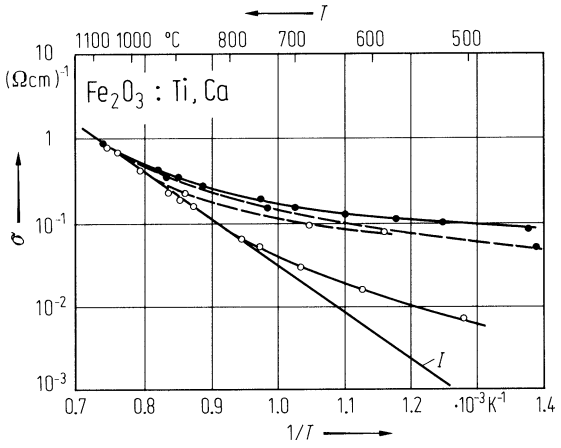

Fig. 8.

Fe_2O_3:Mg. Conductivity vs. reciprocal temperature for Mg doped ceramic samples fired at 1300ºC. (*1*) pure sample, (*2*) 0.01 at% Mg, (*3*) 0.03 at% Mg, (*4*) 0.05 at% Mg, (*5*) 0.2 at% Mg [66G].

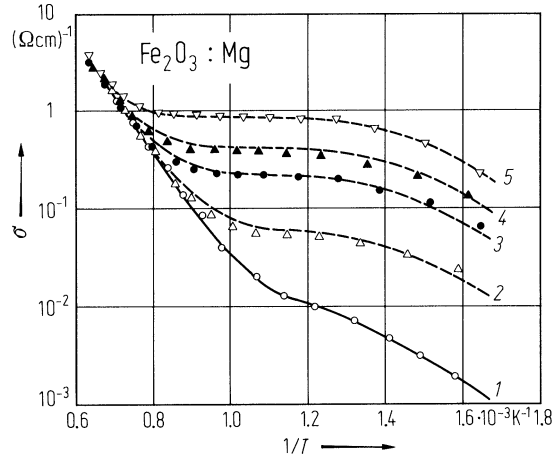

Fig. 9.

Fe_2O_3:Mg. Seebeck coefficient vs. temperature. Samples as in Fig. 8 [66G].