substance: Mn_3O_4
property: transport properties

conduction below phase transition temperature

Conductivity very low at RT ($\rho_n \approx 1.6...6.4\cdot10^8$ Ω cm [66R], ≈ 10^{15} Ω cm extrapolated [75L]). Experiments are complicated by the transition to Mn_2O_3 at lower temperature (Fig. 1). The clear kink in the Mn_3O_4 data at higher p_{O2} is ascribed to intergranular Mn_2O_3 formation. E_A = 1.3 eV in this region [75L]. Seebeck coefficient positive [75L] suggesting p-type conduction.

change in transport properties at T_{tr}

A substantial resistivity anomaly is observed at T_{tr} (1430 K, 25 K hysteresis) with a marked change in slope, from 1.35 eV in the low-temperature phase to 0.65 eV in the high-temperature phase for sintered disks. The Seebeck coefficient has an associated activation energy of 1.2 eV in the tetragonal phase and 0.3 eV in the cubic phase. The melt grown crystals have an associated activation energy from Seebeck measurements of 1.04 eV in the tetragonal phase [81M].

further transport data

(Fig. 2)				
E_A (μ)	0.28...0.38 eV	$T < T_{tr}$	activation energy for drift	81M
	0.52 eV	$T > T_{tr}$	mobility	
E_a	1.04...1.17 eV	$T < T_{tr}$	binding energy of holes to Mn	81M
	0.26 eV	$T > T_{tr}$	vacancies	
μ	$5.3...8.1\cdot10^{-3}$ cm^2/V s	LT phase at T_{tr}	drift mobility	81M
	$1.3\cdot10^{-2}$ cm^2/V s	HT phase at T_{tr}		

References:

66R Rozhdestvenskaya, M. V., Mokievskii, V. A., Stogova, V. A.: Kristallografiya 11 (1966) 903.
75L Logothetis, E. M., Park, K.: Solid State Commun. 16 (1975) 909.
81M Metselaar, R., van Tol, R. E. J., Piercy, P.: J. Solid State Chem. 38 (1981) 335.

Fig. 1.

Mn_3O_4 ceramic. Resistivity vs. (reciprocal) temperature of Mn_3O_4 and Mn_2O_3 in the low-temperature region for (a) p_{O2} = $5{\cdot}10^{-3}$ atm, (b) p_{O2} = 10^{-4} atm. Numbers in (a) refer to the thermal history of the sample [75L]. Vertical arrow indicates transition point between oxides.

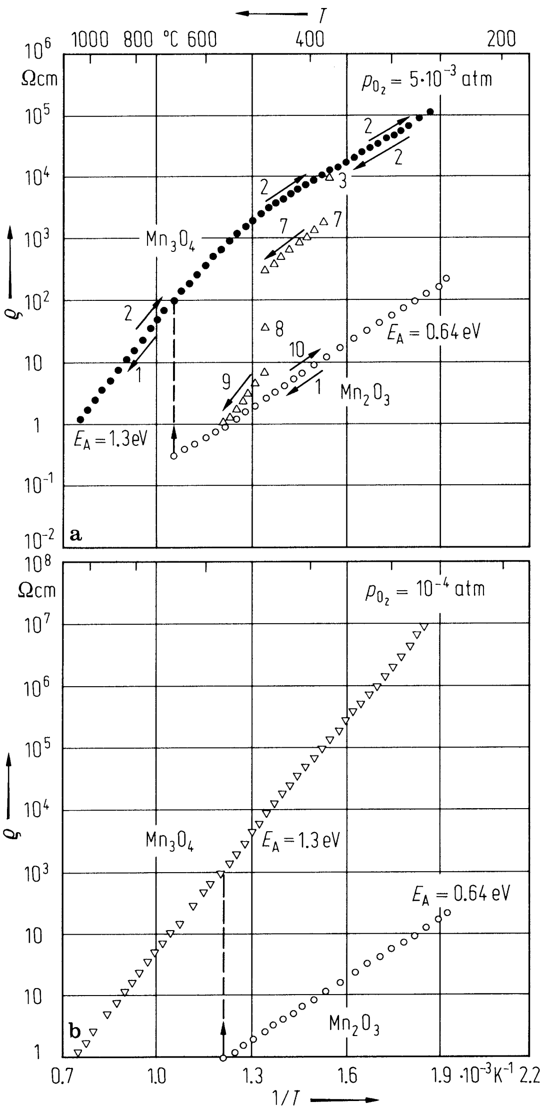

Fig. 2.

Mn_3O_4 ceramic. Resistivity and Seebeck coefficient vs. (reciprocal) temperature for sintered samples at 1 atm oxygen pressure. The arrows indicate the phase boundary for Mn_3O_4/Mn_2O_3, though this transformation is sufficiently slow to permit metastable measurements below this temperature on Mn_3O_4 [81M].