substance: V_2O_5
property: transport properties for doped material

V_2O_5 may be doped interstitially with monovalent ions. Conductivity and Seebeck coefficients for Li- and Na-doped samples: Figs. 1, 2, conductivity of Cu-doped material: Fig. 3, effect of substitutional fluorine doping: Fig. 4 [76C, 71P, 71B].

electrical conductivity and charge carrier concentration (at 25°C) for polycrystalline Li- and Na-doped samples (A obtained from alkali metal concentration, B from electrical conductivity using μ = 0.03 cm^2/V s) (Table from [76C])

	$\sigma \cdot 10^3$ Ω^{-1} cm^{-1}	n [cm^{-3}] A	B	E_A [eV] low temperature	high temperature
V_2O_5	0.05		$1.04 \cdot 10^{16}$	0.21 (300...595 K)	0.37
$Li_{0.002}V_2O_5$	0.115	$1.43 \cdot 10^{19}$	$2.4 \cdot 10^{16}$	0.20 (300...562 K)	0.36
$Li_{0.006}V_2O_5$	0.38	$4.29 \cdot 10^{19}$	$7.9 \cdot 10^{16}$	0.19 (300...515 K)	0.26
$Li_{0.02}V_2O_5$	0.525	$1.43 \cdot 10^{20}$	$1.09 \cdot 10^{17}$	0.18 (300...610 K)	0.10
$Li_{0.06}V_2O_5$	1.51	$4.29 \cdot 10^{20}$	$3.14 \cdot 10^{17}$	0.16 (300...582 K)	0.10
$Na_{0.002}V_2O_5$	0.24	$1.43 \cdot 10^{19}$	$5.0 \cdot 10^{16}$	0.19 (300...549 K)	0.26
$Na_{0.006}V_2O_5$	1.05	$4.29 \cdot 10^{19}$	$2.19 \cdot 10^{17}$	0.17	0.17
$Na_{0.02}V_2O_5$	3.8	$1.43 \cdot 10^{20}$	$7.92 \cdot 10^{17}$	0.15	0.15
$Na_{0.06}V_2O_5$	19.5	$4.29 \cdot 10^{20}$	$4.06 \cdot 10^{18}$	0.13 (300...544 K)	0.10

activation energies and conductivity

(at RT along the *c*-axis) for Cu-doped samples (from [71P])

	E_A [eV] (T > 170 K)	E_A [eV] (T < 170 K)	$\sigma_{\|\|c}$ [Ω^{-1} cm^{-1}] (T = 298 K)
V_2O_5	0.170		$8.3 \cdot 10^{-4}$
V_2O_5	0.189	0.0781	$8.8 \cdot 10^{-4}$
$Cu_{0.0043}V_2O_5$	0.193	0.0758	$8.6 \cdot 10^{-3}$
$Cu_{0.0043}V_2O_5$	0.208	0.0752	$8.4 \cdot 10^{-3}$
$Cu_{0.0062}V_2O_5$	0.235		$9.1 \cdot 10^{-3}$
$Cu_{0.0083}V_2O_5$	0.222	0.0759	$14.4 \cdot 10^{-3}$
$Cu_{0.02}V_2O_5$	0.237	0.0790	$12.9 \cdot 10^{-3}$

activation energies, conductivity (at RT) and Seebeck coefficient for W-doped polycrystalline samples

(from [79P]):

x = W/V_2O_5	S [μV K^{-1}]	σ [Ω^{-1} cm^{-1}]	E_A [eV]
0	– 200	$1.5 \cdot 10^{-5}$	0.20
0.005	– 50	$2.86 \cdot 10^{-2}$	0.24
0.01	– 48	$3.13 \cdot 10^{-2}$	0.24
0.02	– 40	$3.63 \cdot 10^{-2}$	0.23
0.03	– 30	$4.17 \cdot 10^{-2}$	0.22

conductivity: Fig. 5 (note discrepancy to values in table above); Seebeck coefficient: Fig. 6. Evidence suggests that W^{6+} ions are interstitial and main contribution to activation energy is from small polaron hopping [79P].

References:

71B Bayard, M. L. F., Reynolds, T. G., Vlasse, M., McKinzie, H. L., Arnott, R. J., Wold, A.: J. Solid State Chem. 3 (1971) 484.
71P Perlstein, J. H.: J. Solid State Chem. 3 (1971) 217.
76C Chakrabarty, D. K., Guha, D., Biswas, A. B.: J. Mater. Sci. 11 (1976) 1347.
79P Palanna, O. G.: Indian J. Chem. 17A (1979) 442.

Fig. 1.

V_2O_5. Conductivity of interstitially alkali-metal doped polycrystalline samples vs. reciprocal temperature [76C].

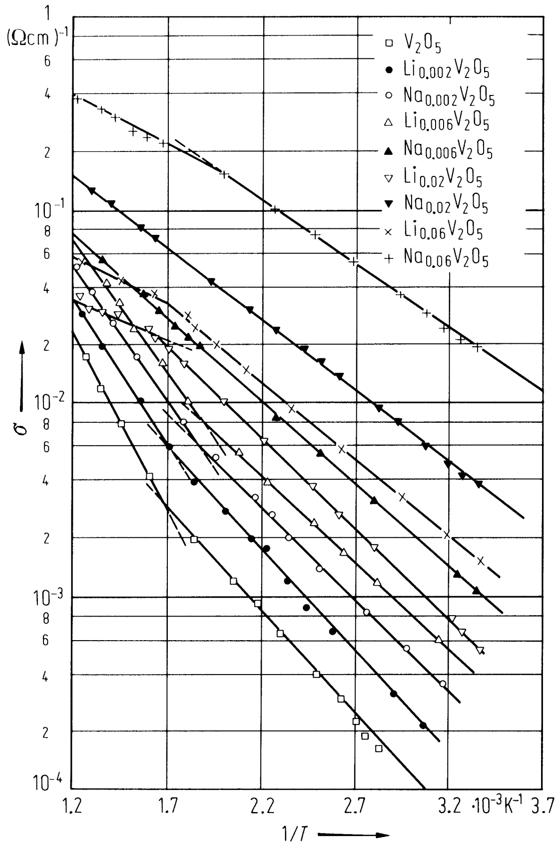

Fig. 2.

V_2O_5. Seebeck coefficients vs. temperature for interstitially alkali-metal doped polycrystalline samples [76C].

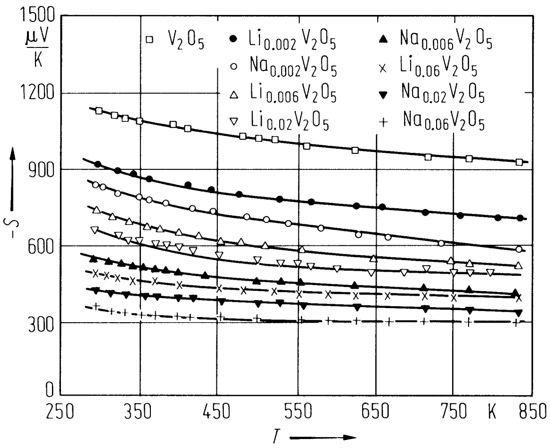

Fig. 3.

V_2O_5. Natural logarithm of conductivity vs. (reciprocal) temperature for Cu-doped samples [71P]. σ in Ω^{-1} cm^{-1}, $\sigma \parallel c$.

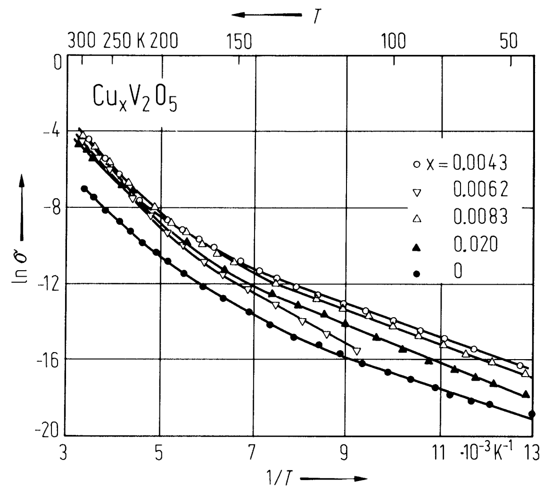

Fig. 4.

$V_2O_{5-x}F_x$. Resistivity vs. reciprocal temperature for two samples of different composition [71B]. Orientation not specified.

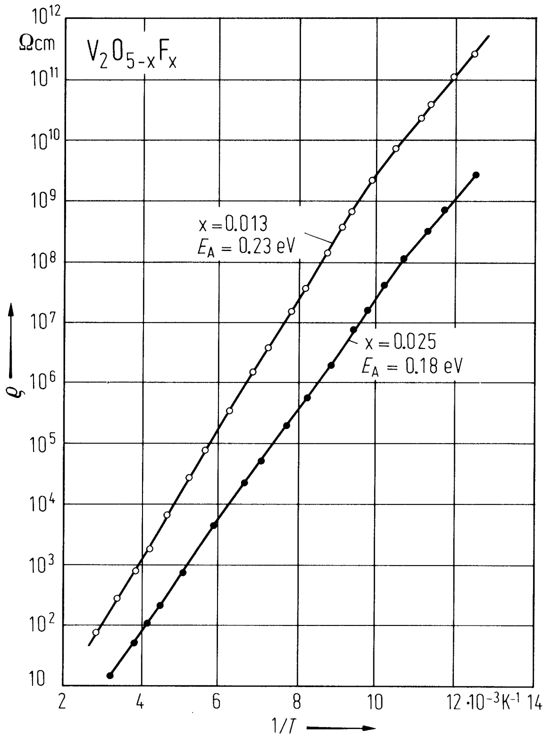

Fig. 5.

$W_xV_2O_5$. Conductivity times temperature vs. (reciprocal) temperature for polycrystalline samples. *1*: x = 0.005, *2*: x = 0.01, *3*: x = 0.02, *4*: x = 0.03 [79P].

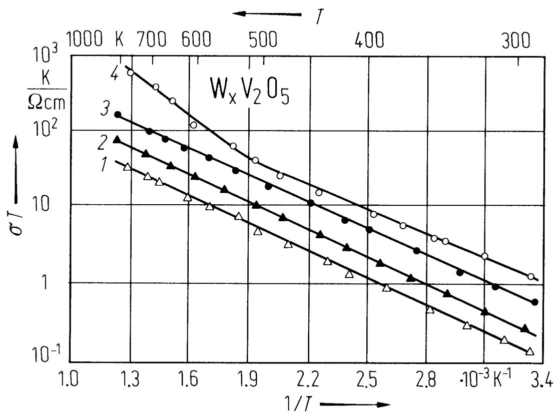

Fig. 6.

$W_xV_2O_5$. Seebeck coefficient vs. (reciprocal) temperature for polycrystalline samples [79P]. Curve numbering as for Fig. 5.