substance: MnS
property: crystal structure, physical properties

α-MnS

(S: structure (space group), CG: crystal growth (the numbers in parentheses correspond to T_1 and T_2, the temperatures (in ^oC) of the hot and cold end of the crystal growth tube, respectively), C: colour).

(The references in the last column refer to all data of α-MnS)

lattice parameters

a	5.223 Å	$T > T_N$	S: cubic B1, O_h^5 – Fm3m; $T < T_N$:	56C,
a	5.198 Å	$T < T_N$	trigonal distortion; anti-	67H,
β	90.099°		ferromagnetic, T_N = 130 K,	67S,
			p_{eff} = 5.6 μ_B, Θ_p = – 465 K.	70M,
			Ferromagnetic (111) sheets	70R,
			coupled antiparallel; spins	70W,
			in ferromagnetic (111) planes	71L,
			CG: (i) in silica gel between	78H
			4°C and 41°C, (ii) halogen	
			transport (1050/550)	
			C: green	

resistivity, Seebeck coefficient

ρ	10^3 Ω cm	p-type,
S	850 μV K^{-1}	synthetic single
		crystal

Hall mobility

μ_H	10 cm^2/V s	T = 625 K

Hall coefficient

R_H	10^2 cm^3/C

energy gap

E_g	2.8 eV		optical gap
	3.2 eV		direct gap, calculated
$E_{g,th}$	0.62 eV	T < 435 K	
	3.0 eV	T > 590 K	

β-MnS

lattice parameters

a	5.606 Å		structure: cubic, B3, T_d^2 – F $\bar{4}$ 3m,	56C,
			antiferromagnetic, T_N = 160 K,	71L
			p_{eff} = 5.82 μ_B, Θ_p = – 982 K,	
			fcc ordering of 3rd kind;	
			spins along c axis of tetragonal	
			magnetic cell	

γ-MnS

(S: structure (space group), CG: crystal growth, C: colour).

lattice parameters

a	3.99 Å	S: hexagonal, B4, C_{6v}^4 – $P6_3mc$,	56C,
c	6.47 Å	antiferromagnetic, T_N = 100 K,	67S,
		p_{eff} = 6.1 μ_B, Θ_p = – 932 K.	71L
		Pairs of ferromagnetic (011) sheets of orthorhombic cell coupled antiparallel ($a_{orth} = 3^{1/2}a_{hex}$, $b_{orth} = 2a_{hex}$, $c_{orth} = c_{hex}$), spins along ortho-[0 1 1]	
		CG: in silica gel between 4°C and 41°C	
		C: pink	

Figures to this document:

resistivity: Fig. 1

Seebeck coefficient: Fig. 2

Hall coefficient: Fig. 3

magnetic susceptibility: Fig. 4

References:

56C Corliss, L. M., Elliott, N., Hastings, J. M.: Phys. Rev. 104 (1956) 924.
67H Huffman, D. R., Wild, R. L.: Phys. Rev. 156 (1967) 989.
67S Schwartz, A., Tauber, A., Shappirino, J. R.: Mater. Res. Bull. 2 (1967) 375.
70M Morosin, B.: Phys. Rev. B1 (1970) 236.
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78H Heikens, H. H., Van Bruggen, C. F., Haas, C.: J. Phys. Chem. Solids 39 (1978) 833.

Fig. 1.

α-MnS. Electrical resistivity vs. temperature [78H].

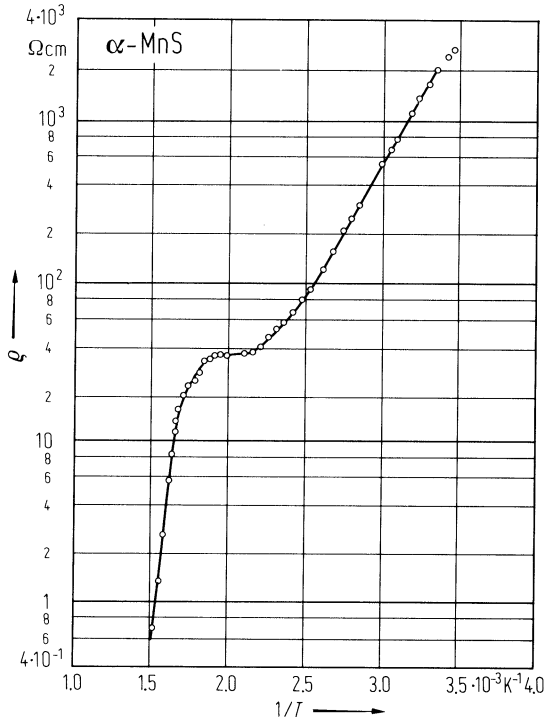

Fig. 2.

α-MnS. Seebeck coefficient vs. reciprocal temperature for a single crystal grown by iodine-vapour transport and quenched from 600 K. First heating curve: *a*, second heating curve: *b*, ultimate behaviour: *c* [78H].

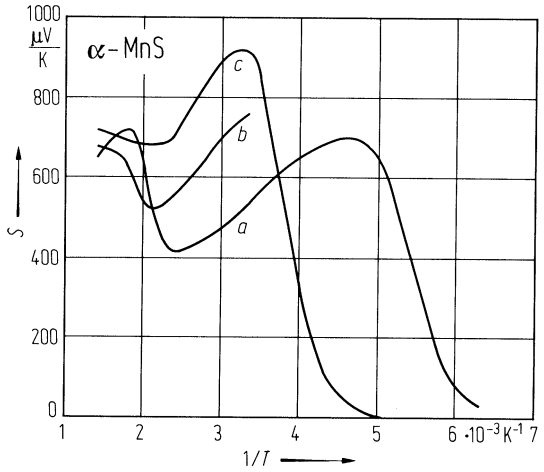

Fig. 3.

α-MnS. Hall coefficient vs. reciprocal temperature for a sintered bar [78H].

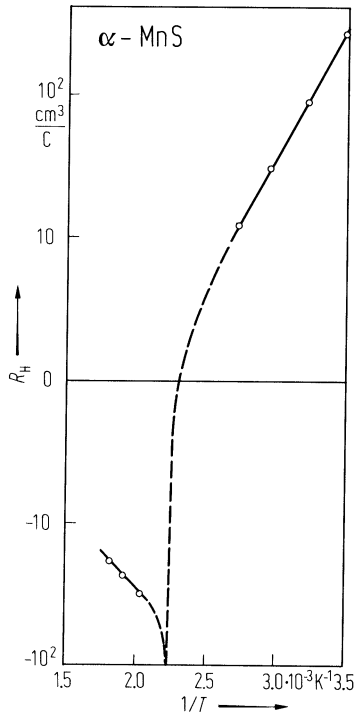

Fig. 4.

MnS. Inverse magnetic molar susceptibility vs. temperature for 3 modifications [56C]. χ_m in CGS- emu.