substance: Mn_nSi_{2n-m}
property: physical properties of $Mn_{15}Si_{26}$

Single crystal boules of $MnSi_{\approx 1.73}$ grown by the Bridgman technique contained about 2 vol.% of plate-like MnSi precipitates parallel to [001] of the matrix $Mn_{15}Si_{26}$ (stoichiometry deduced from X-ray diffraction patterns; electron microprobe X-ray analysis yielded $MnSi_{1.717}$ which is closer to $Mn_{11}Si_{19}$). Electrical measurements were corrected for the contribution of the metallic MnSi.

energy gap

E_g	0.702 eV	T = 0 K	from log $p \propto E_g/2kT$ measured along [001] and along [100]	81K
	0.70 eV	T = 900...1200 K	from $\log(R_H T^{3/2}) \propto E_g/2kT$	81K

effective masses

m_p	11 m_0	along [100]	from thermoelectric power near 600 K	81K
	15 m_0	along [001]		

hole mobilities

μ_p	1.2 $T^{-3/2}$ cm^2/V s	along [100], T > 200 K	Hall mobility; temperature dependence shows that acoustic phonon scattering is dominant (Fig. 1)	81K
	0.62 $T^{-3/2}$ cm^2/V s	along [001] T > 600 K		

mobility ratios

b	0.02		from $\rho(T)$ between extrinsic and intrinsic region with Hunter's method, confirmed by thermopower	81K
	0.017	from $\rho^{[100]}$		
	0.023	from $\rho^{[001]}$		

carrier concentrations from resistivity and Hall coefficient: Fig. 2; $n \approx p$ above 1000 K [81K], electrical resistivity: Fig. 3, Hall coefficient is isotropic at 77...1200 K: Fig. 4, thermoelectric power: Fig. 5

anisotropy of intrinsic resistivity
(in Ω cm)

ρ_i	$4.42 \cdot 10^{-5} \exp(4073/T)$	along [100]	81K
	$1.09 \cdot 10^{-4} \exp(4073/T)$	along [001]	

On a sample with 47 wt% Si (= $MnSi_{1.733}$) a carrier concentration $n = 9 \cdot 10^{19}$ cm^{-3} was found to be constant in the range 300...700 K. From the resistivity in the range 300...700 K an energy gap $E_g \approx 0.6$ eV was derived [81K]. A very similar behavior was observed on a sample containing 47.5 wt% Si (= $MnSi_{1.770}$) . Curie-Weiss-type paramagnetism was reported for alloys with 46.0, 46.3, 46.5, 46.8, 47.0 and 47.3 wt% Si [65R].

References:

65R Radovskiy, I. Z., Sidorenko, F. A., Geld, P. V.: Fiz. Metal. Metalloved. 19 (1965) 514 (translation: Phys. Met. Metallogr. 19, Nr. 4 (1965) 30).

81K Kawasumi, I., Sakata, M., Nishida, I., Masumoto, K.: J. Mater. Sci. 16 (1981) 355.

Fig. 1.

$Mn_{15}Si_{26}$. Hall mobilities of holes $\mu_{H,p} = R_H/\rho$ in [100] and [001] direction vs. reciprocal temperature in a doubly-logarithmic scale [81K]. The straight lines correspond to a $T^{-3/2}$ law.

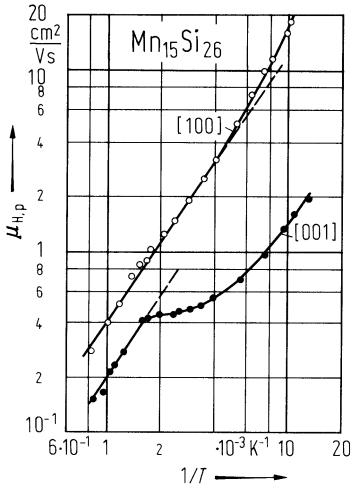

Fig. 2.

$Mn_{15}Si_{26}$. Charge-carrier concentrations from resistivity and Hall coefficient vs. reciprocal temperature [81K].

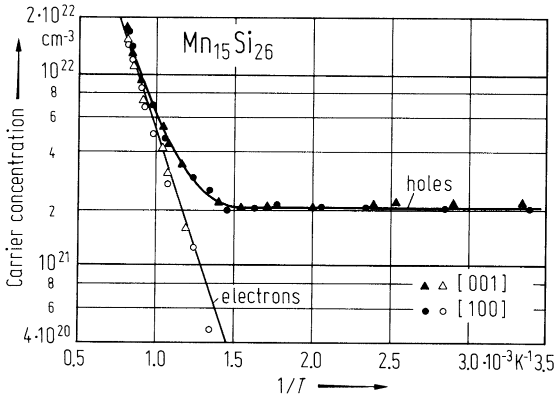

Fig. 3.

$Mn_{15}Si_{26}$. Resistivity vs. reciprocal temperature [81K]. $\rho^{[100]}$ and $\rho^{[001]}$: measured along the *a*- and along the *c*-direction, respectively.

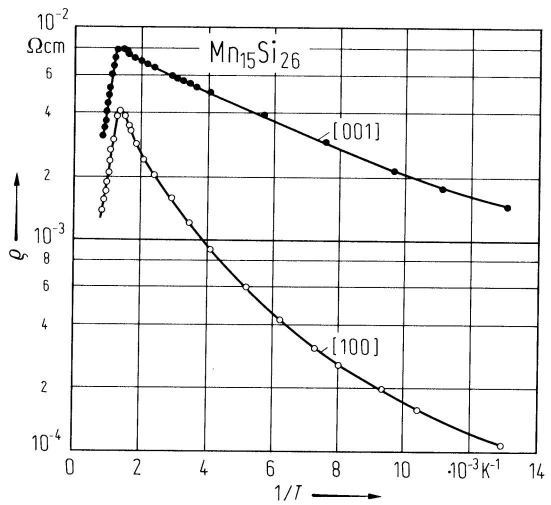

Fig. 4.

$Mn_{15}Si_{26}$. Hall coefficient vs. reciprocal temperature [81K].

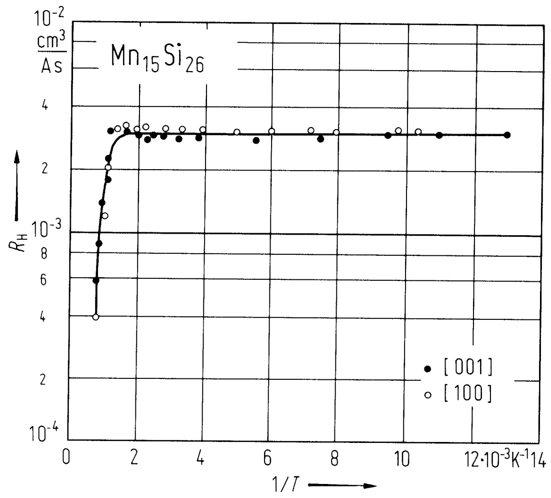

Fig. 5.

$Mn_{15}Si_{26}$. Thermoelectric power vs. temperature [81K]. $S^{[100]}$ and $S^{[001]}$: measured with the temperature gradient along *a* and *c*, respectively. Solid curves are calculated with the formula for degenerate p-type semiconductors.