substance: $FeSi_2$
property: optical properties, dielectric constants

reflectivity and optical constants of orthorhombic $FeSi_2$: Figs. 1...6.

The reflectivity of p-type $FeSi_2$ can be interpreted with Drude's theory of free-carrier absorption in contrast to the case of n-type $FeSi_2$. A consistent interpretation of the optical properties of n-type $FeSi_2$ is possible in terms of the small-polaron picture [70B2, 72B].

dielectric constants

$\varepsilon(0)$	61.6	RT, polycryst.	from a Kramers-Kronig analysis of reflectivity in the range 1...50 μm	68B, 73W
$\varepsilon(\infty)$	27.6	RT, polycryst.		68B

References:

68B Birkholz, U., Finkenrath, H., Naegele, J., Uhle, N.: Phys. Status Solidi 30 (1968) K81.

70B1 Birkholz, U., Frühauf, A., Schelm, J.: Proc. Tenth Int. Conf. Phys. Semicond., Cambridge, Mass. (1970) 311.

70B2 Birkholz, U., Naegele, J.: Phys. Status Solidi 39 (1970) 197.

72B Baltz, R. v., Birkholz, U.: Festkörperprobleme XII, Pergamon/Vieweg 1972, 233.

73W Waldecker, G., Meinhold, H., Birkholz, U.: Phys. Status Solidi (a) 15 (1973) 143.

Fig. 1.

$FeSi_2$. Reflectivity vs. wavelength in a doubly-logarithmic scale at RT [70B1, 70B2]. Comparison with the metallic metastable high-temperature phase mixture $2yFeSi + Fe_{1-y}Si_2$.

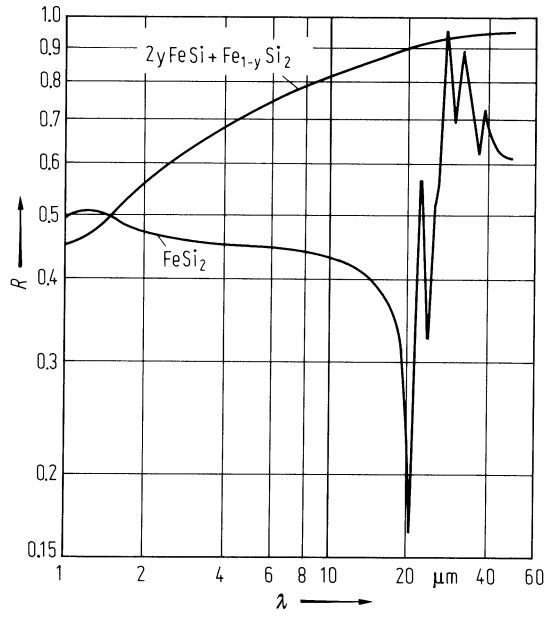

Fig. 2.

$FeSi_2$. Reflectivity vs. wavelength in the range of lattice vibrations [68B].

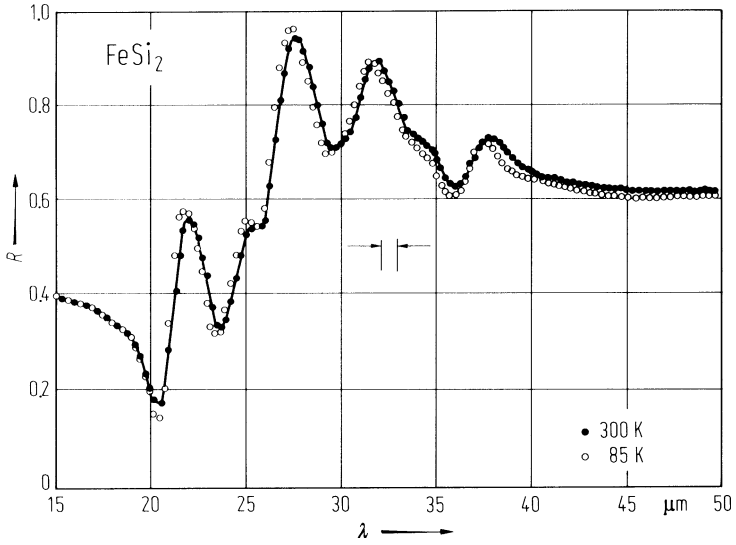

Fig. 3.

$FeSi_{2-y}Al_y$. Reflectivity vs. wavelength of p-type samples, showing the effect of additional free charge carriers on the absorption and the shift of the reflectivity minimum towards shorter wavelengths (20 μm) [70B2]. Full circles: undoped, open circles: y = 0.0105, $\sigma_{300K} = 50\ \Omega^{-1}\ cm^{-1}$ (and $S_{300K} = +280\ \mu V\ K^{-1}$) Full line calculated for the Al-doped sample with the Drude theory assuming a relaxation time $\tau_D = 6 \cdot 10^{-15}$ s.

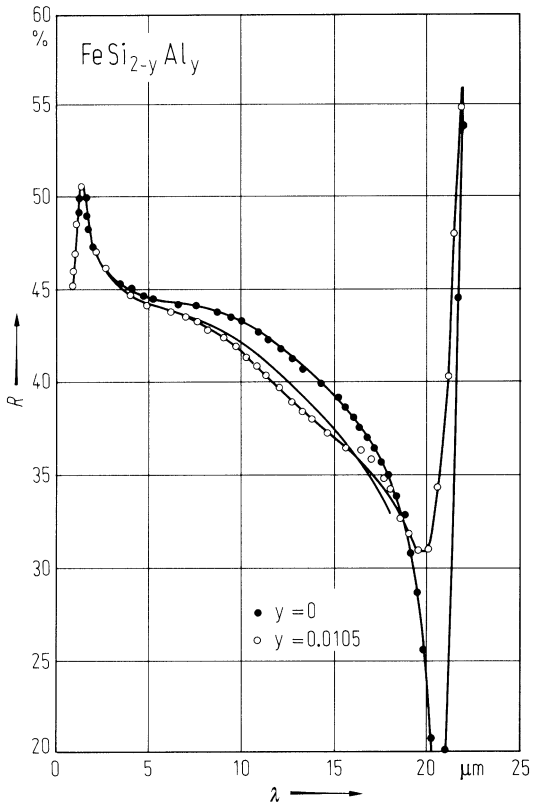

Fig. 4.

$FeSi_2$ and $FeSi_{2-y}Al_y$. Refractive index n and ahsorption coefficient K vs. wavelength [70B2]. Upper curve: Measurements on an undoped p-type $FeSi_2$ sample (S = +280 μV K^{-1}). Other curves: Calculated according to Drude with $\tau_D = 6 \cdot 10^{-15}$ s for a sample with y = 0.0105, $\sigma_{300K} = 50\ \Omega^{-1}\ cm^{-1}$.

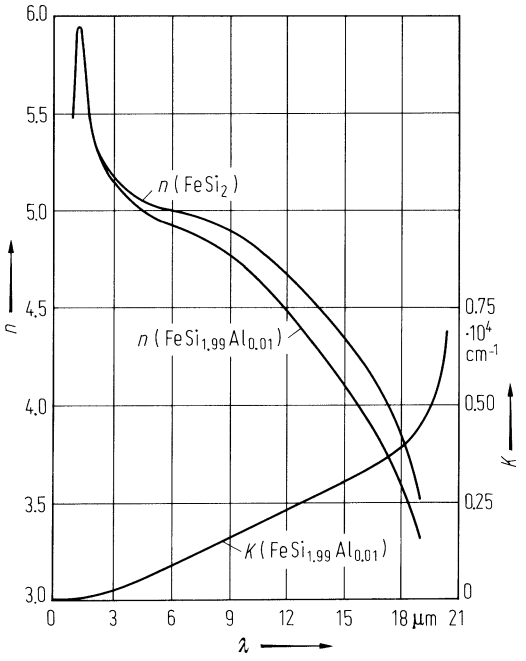

Fig. 5.

$Fe_{1-x}Co_xSi$ Reflectivity vs. wavelength [70B2]. No dopant-dependent shift of the 1.3 μm maximum (which corresponds to the fundamental absorption). x = 0: $\sigma_{300K}[\Omega^{-1}cm^{-1}]$ = 0.3, $S_{300K}[\mu VK^{-1}]$ = –460; x = 0.01: $\sigma_{300K}[\Omega^{-1}cm^{-1}]$ = 18, $S_{300K}[\mu VK^{-1}]$ = –380; x = 0.03: $\sigma_{300K}[\Omega^{-1}cm^{-1}]$ = 53, $S_{300K}[\mu VK^{-1}]$ = –230; x = 0.06: $\sigma_{300K}[\Omega^{-1}cm^{-1}]$ = 110, $S_{300K}[\mu VK^{-1}]$ = –150.

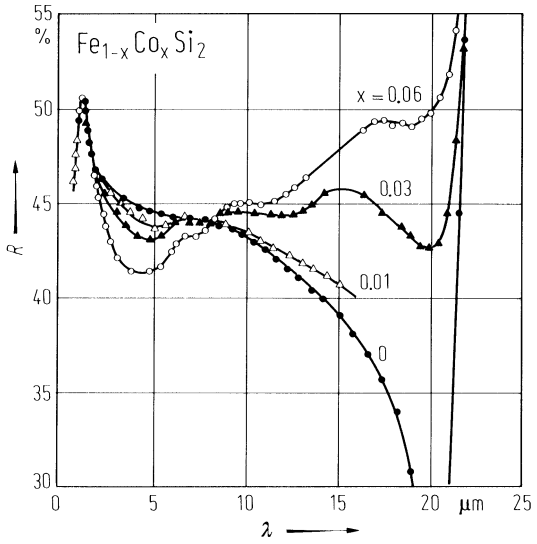

Fig. 6.

$Fe_{1-x}Co_xSi_2$. Refractive index vs. wavelength of n-type samples calculated with Reik's small-polaron theory [70B2]. The same samples as in Fig.5.