substance: EuSe
property: crystal structure, physical properties

crystal structure cubic (O_h^5 – Fm3m)

lattice parameters

a	6.195 Å			72W1, 79W
	6.1936(2) Å	T = 298.15 K		74M

melting point

T_m	2488(8) K			72R

density

d	6.455 g cm^{-3}			74M

energy gap

E_g(4f – 5d)	1.80 eV		optical spectroscopy	72W1
	1.78 eV		optical spectroscopy	71G
dE_g/dp	– 8.4 meV kbar^{-1}		opt. absorption	69W

bulk modulus

B_0	530(110) kbar			70L
	480(50) kbar			71S
	520(50) kbar			74J

linear thermal expansion coefficient

α	18.2·10^{-6} K^{-1}			66D
	13.1·10^{-6} K^{-1}			69L

elastic moduli

c_{11}	11.6(4)·10^{10} Pa	T = 77 K		71S,
c_{12}	1.2(6)·10^{10} Pa	T = 77 K		72S
c_{44}	2.28(9)·10^{10} Pa	T = 77 K		

compressibility

κ	1.9·10^{-11} Pa^{-1}			70L

sound velocity

$\upsilon_{[100]}$	4.22·10^5 cm s^{-1}	T = 77 K		71S

Debye temperature

Θ_D	153(9) K			80S2
	180 K			64B
	220 K			66D
	232 K			71S
	176(9) K			72W2

heat capacity

C_p	51.34 J mol^{-1} K^{-1}			74M

phonon wavenumbers

$(\nu/c)_{TO}$	130 cm^{-1}	T = 4.2 K[a])		80S1
	127.8(5) cm^{-1}	T = 300 K[b])		69A
	134 cm^{-1}	T = 2 K[b])		73I
$(\nu/c)_{LO}$	176 cm^{-1}	T = 4.2 K[a])		80S1
	182(3) cm^{-1}	T = 300 K[b])		69A
	189 cm^{-1}	T = 2 K[b])		73I
$(\nu/c)_{TA}$	56 cm^{-1}	T = 4.2 K[a])	[a]) from Raman scattering	80S1
$(\nu/c)_{LA}$	79cm^{-1}	T = 4.2 K[a])	[b]) from IR measurements	80S1

dielectric constants

$\varepsilon(0)$	9.4(8)			69A
	9.5			74G
$\varepsilon(\infty)$	5.3			68W
	5.35			74G

refractive index

n	2.43	at 4f – 5d absorption edge		71G

f-d transition energy

E(4f – 5d)	1.78 eV	edge		71G
E(4f – 5d)	2.55 eV	maximum		75S

absorption coefficient

K	$1.50 \cdot 10^5$ cm^{-1}	max. 4f – 5d trans.		75S

oscillator strength

f	0.20		oscillator strength of 4f – 5d transition	71G

f-d transition width

W(4f – 5d)	0.7 eV		width of 4f – 5d transition	

photothreshold

E_{thr}	4.5(1) eV		ionization energy (photothreshold)	76M

work function

ϕ	3.90(15) eV		work function	76M
	4.00(15) eV			

electrical conductivity

σ	≈ 10^{-1} Ω^{-1} cm^{-1}	T = 76 K		78H
	50 Ω^{-1} cm^{-1}			74S
	10^{-7} Ω^{-1} cm^{-1}		high resistivity sample	
	1...10 Ω^{-1} cm^{-1}	n-type		81Y

electron concentration

n	$0.42...3.5 \cdot 10^{19}$ cm^{-3}		74S
	$\approx 10^{18}$ cm^{-3}		81Y

activation energy for conductivity

E_A	11...20 meV	T = 20...50 K	81Y

Hall mobility

μ_H	0.5 cm^2 V^{-1} s^{-1}	B = 5 T, T = 76 K	78H

Figures and further references:

band structure: Figs. 1, 2

temperature dependence of **band gap**: Fig. 3

band structure and electron-electron interaction [81F]; MO calculation [81Z]

density of states: Fig . 17

phonon dispersion relations: Fig. 4

Raman spectra: Fig. 5

phonon energies in various magnetic phases [80S1, 79S]

real and imaginary parts of the **dielectric constant**: Figs. 19, 20

absorption spectrum: Fig. 18

luminescence and excitation spectra: Figs. 6, 7

photosensitivity: Figs. 21, 8

temperature dependence of **ac- and dc-conductivity**: Figs. 9, 10; electrical conductivity vs. magnetic field: Figs. 11, 12

magnetically stimulated current vs. temperature: Fig. 13

dc- and microwave conductivity: Fig. 14

Hall voltage vs. magnetic field: Fig. 15

comparison of **conductivity, carrier concentration and Hall mobility**: Fig. 16

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Fig. 1.

EuSe. Energy band structure. Solid lines for up-spin electron, dashed lines for down-spin electrons [70C].

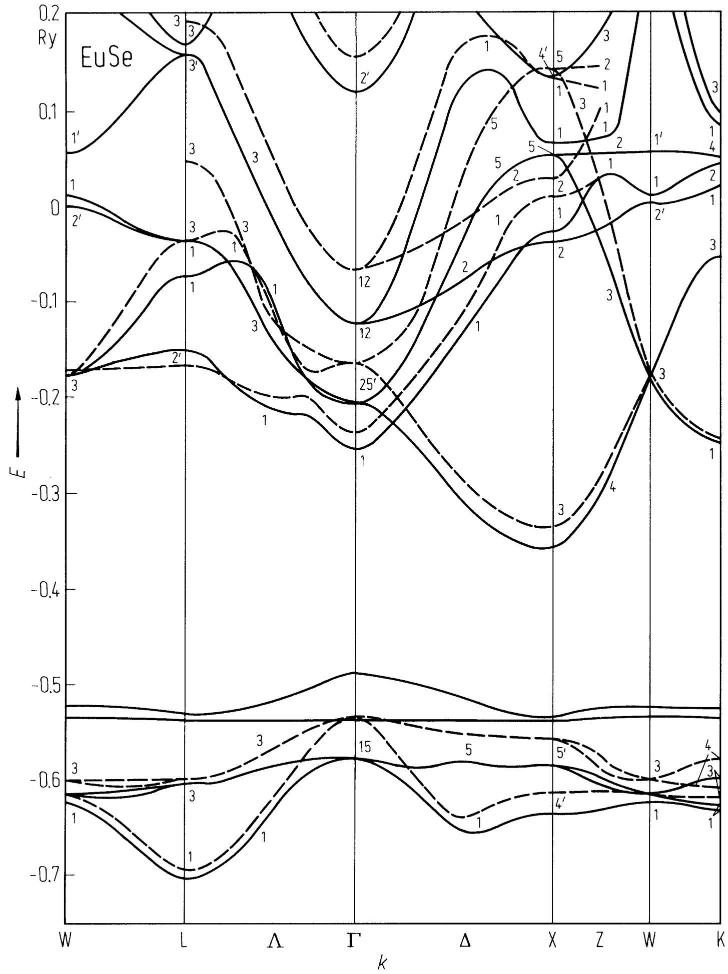

Fig. 2.

EuSe. Spin polarized energy bands. (a): Spin-up, (b): spin-down [81F].

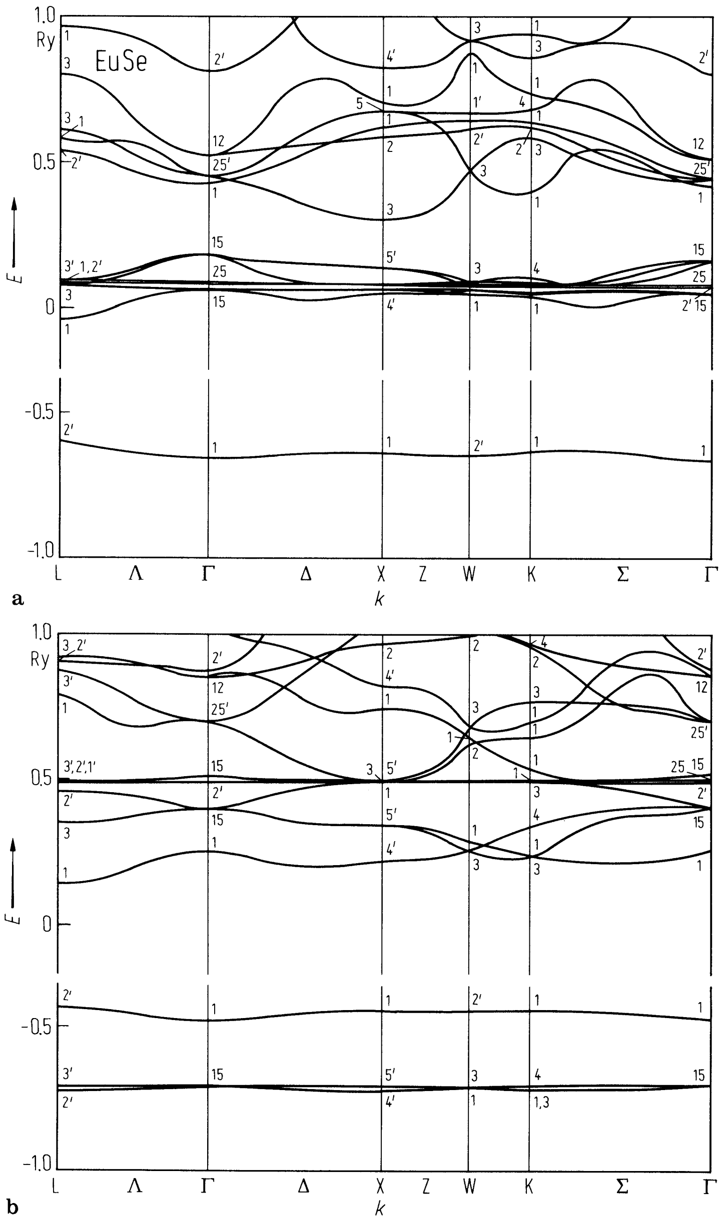

Fig. 3.

EuSe. Absorption edge vs. temperature with and without an external magnetic field of 14.5 kOe [72W1].

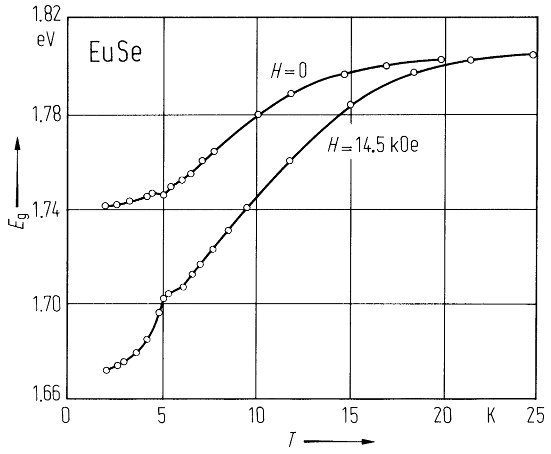

Fig. 4.

EuSe. Phonon dispersion relations along the [111]-direction deduced from Raman spectra. The points at 134 cm^{-1} and 118 cm^{-1} are taken from IR data and from a spin-fluctuation effect, respectively [80S1].

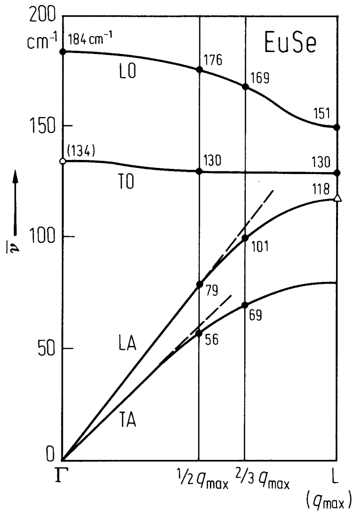

Fig. 5.

EuSe. Raman spectra (Raman intensity vs. Raman shift) at different temperatures [80S1]. Laser energy E_L = 1.91 eV (for T = 1.7 K, E_L = 1.83 eV), scattering geometry $y(zx+zy)z$, H_A = 0.

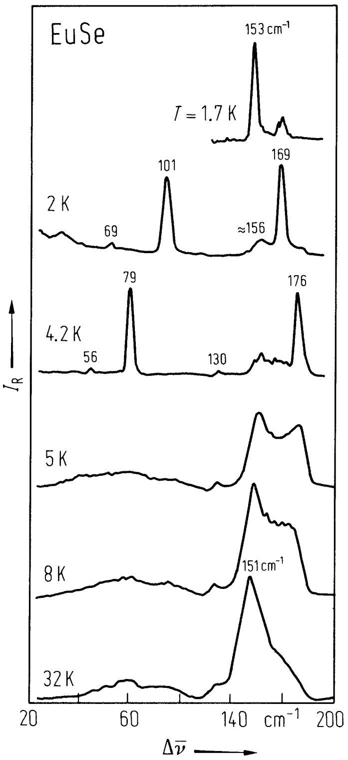

Fig. 6.

EuSe. Relative quantum yield of the luminescence vs. photon energy at 4.3 K [72W1].

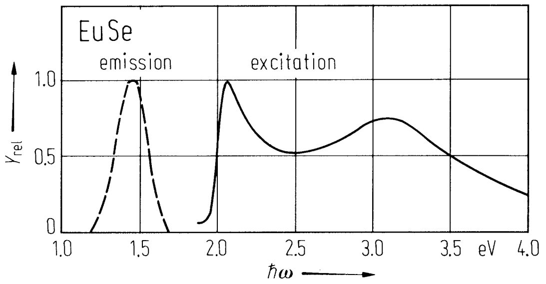

Fig. 7.

EuSe. Emission spectrum (relative intensity vs. photon energy) (a) at 51 K, (b) at 4.3 K, (c) at 4.3 K with a magnetic field of 11 kOe [72W1].

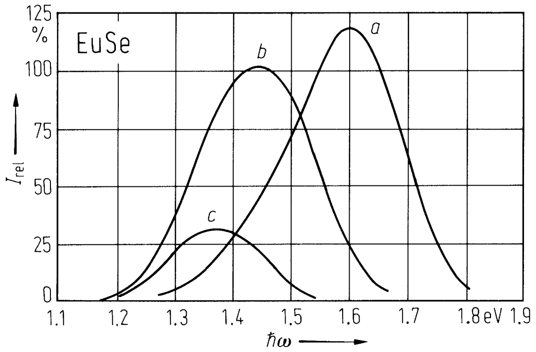

Fig. 8.

EuSe. Photosensitivity (photo current / light intensity) vs. photon energy. Also shown is the absorption coefficient [72W1].

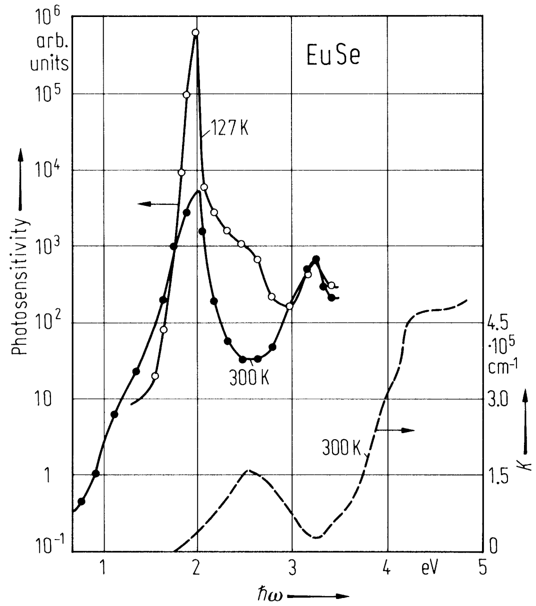

Fig. 9.

EuSe. dc- and ac- conductivity vs. reciprocal temperature [78K].

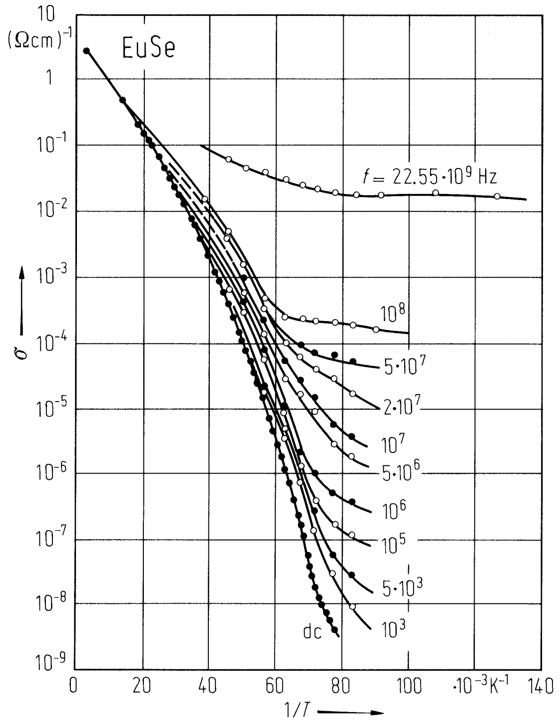

Fig. 10.

EuSe. dc and ac- conductivity at low temperatures [78K]. Triangles are results from other literature.

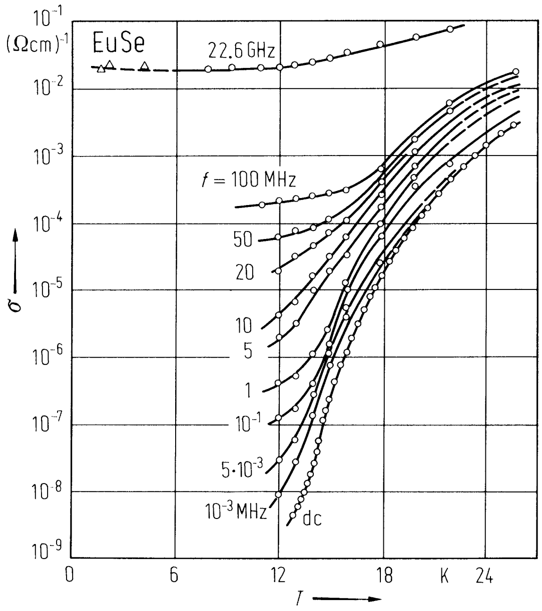

Fig. 11.

EuSe. dc- and ac-conductivity vs. external magnetic field at 4.2 K [78K].

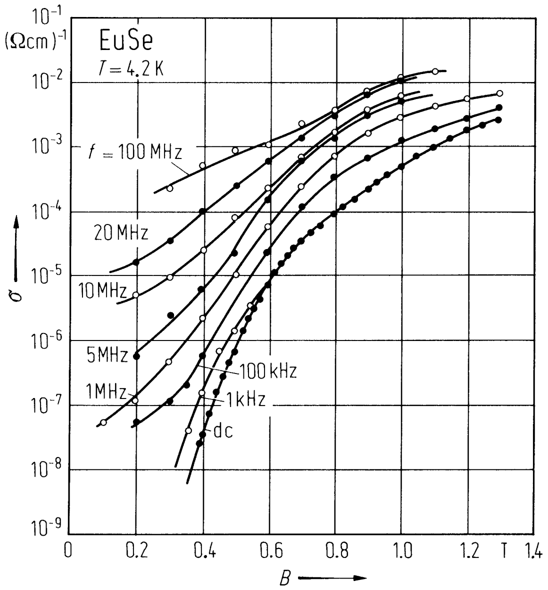

Fig. 12.

EuSe. dc- and ac-conductivity vs. external magnetic field at 10 K [78K].

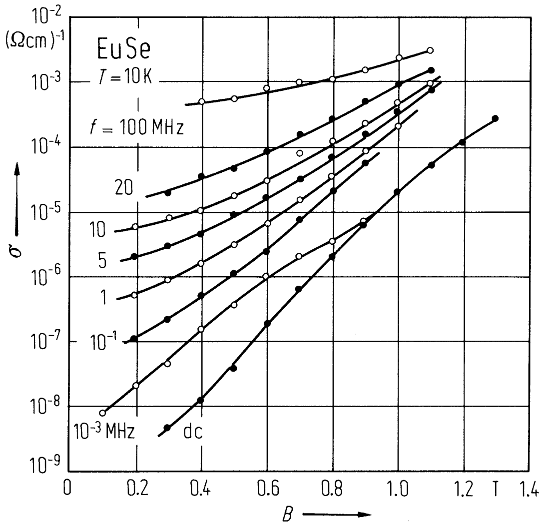

Fig. 13.

EuSe. Temperature dependence of magnetically stimulated current I_{MSC} at different external magnetic fields [81Y].

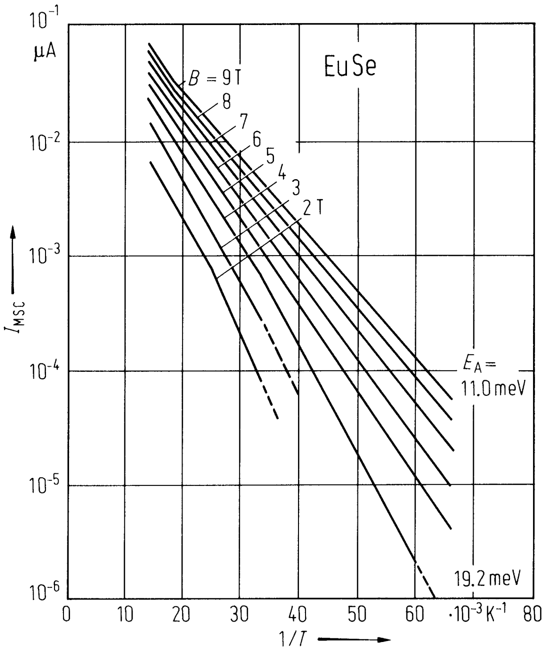

Fig. 14.

EuSe. dc and microwave (MW) conductivities vs. external magnetic field at 4.2 K. The r.f. frequency was 24 GHz [81K].

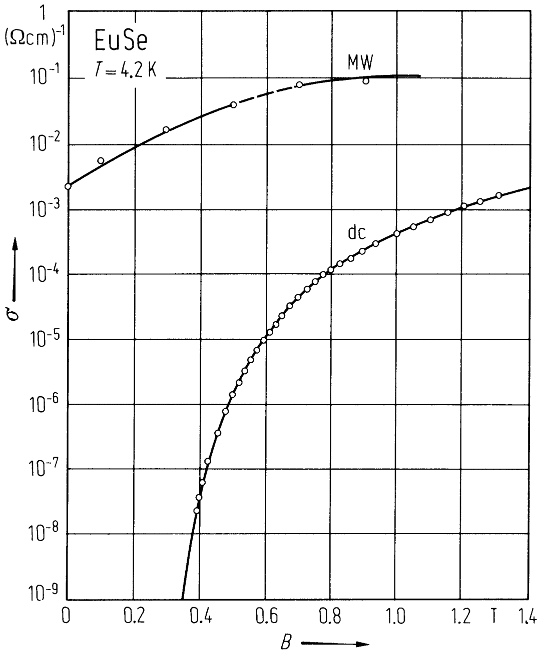

Fig. 15.

EuSe. Hall voltage vs. internal magnetic field at different temperatures. The dashed lines represent an extrapolation from the high field region to the low field region [78H].

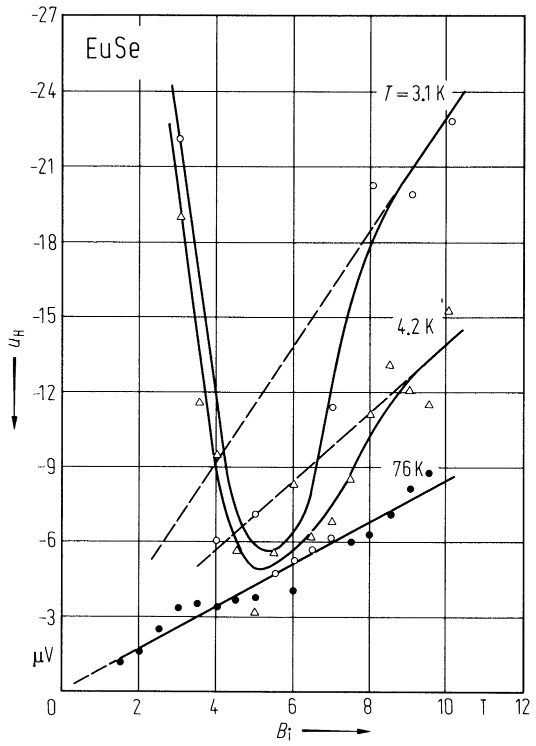

Fig. 16.

EuSe. Conductivity, carrier concentration and Hall mobility vs. internal magnetic field at different temperatures [78H].

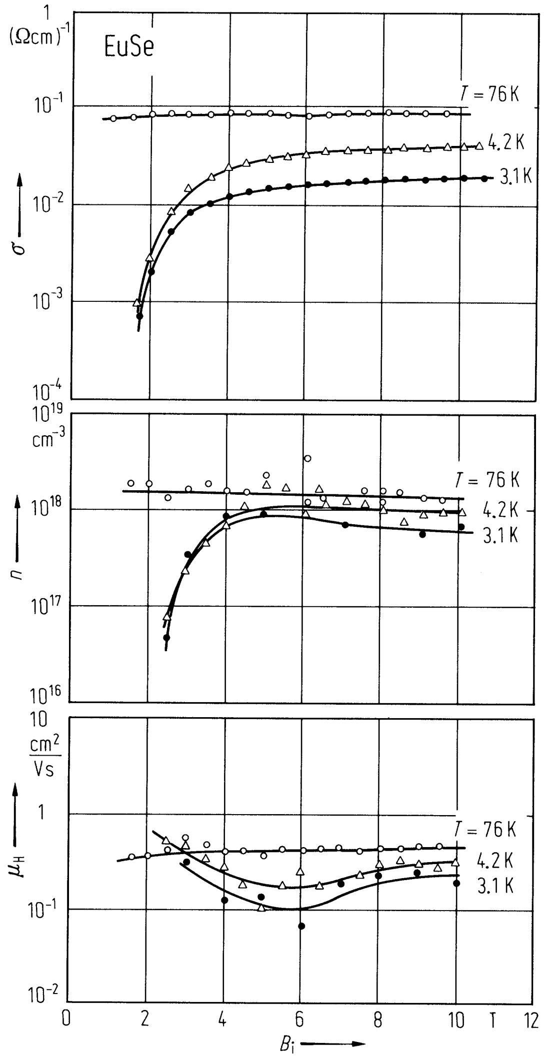

Fig. 17.

Eu-chalcogenides. Schematic density of states [79W].

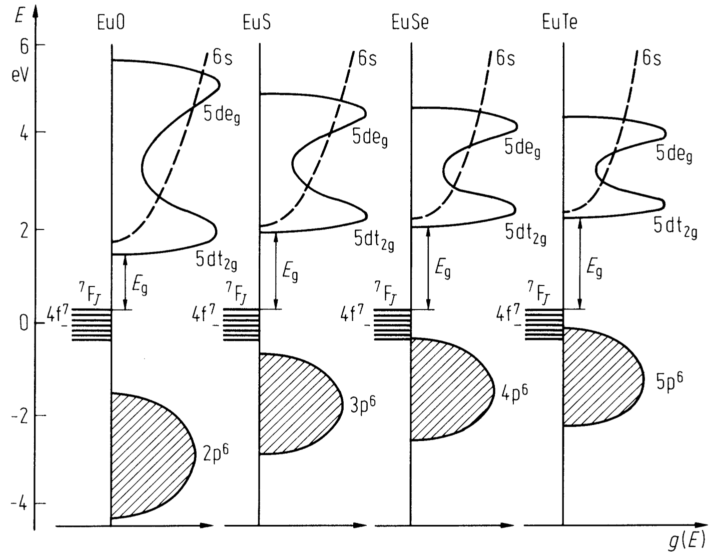

Fig. 18.

Eu-chalcogenides. Absorption coefficient vs. photon energy at 300 K, from reflectivity measurements [74G].

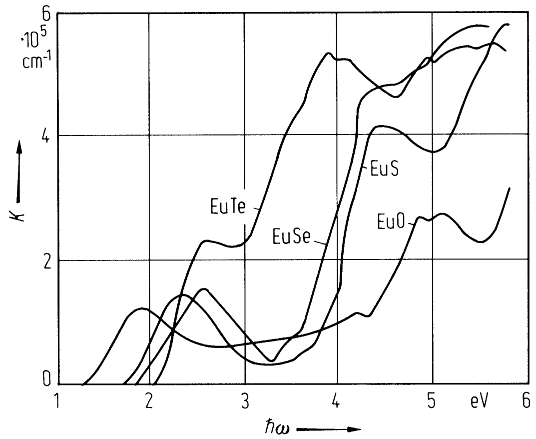

Fig. 19.

Eu-chalcogenides. Real part of the dielectric constant vs. photon energy at 300 K [74G].

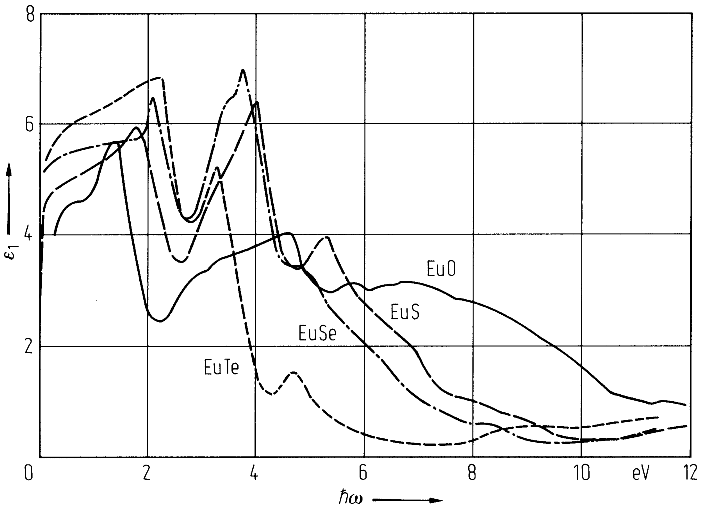

Fig. 20.

Eu-chalcogenides. Imaginary part of the dielectric constant vs. photon energy at 300 K [74G].

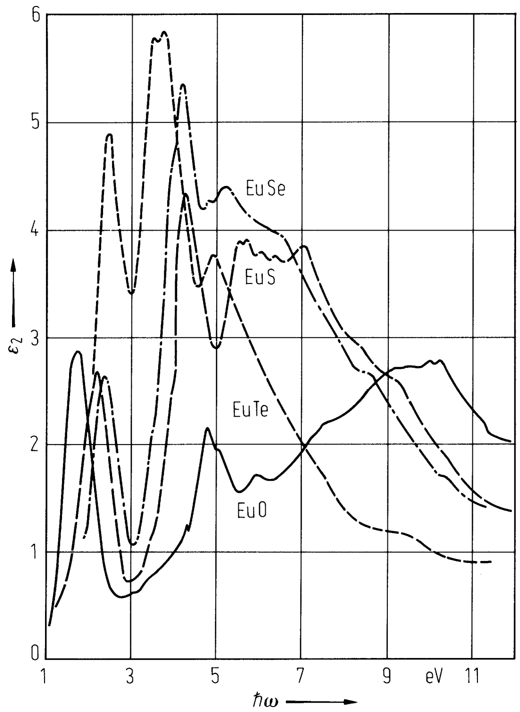

Fig. 21.

Eu-chalcogenides. Photosensitivity (photo current / light intensity) vs. temperature. The exciting wavelength is kept at the maximum of the photo-response [72W1].