substance: boron compounds with group III elements
property: properties of Al-Mg-B and Al-Cu-B compounds

$Al_{1.44}Mg_{0.65}B_{22}$

β-tetragonal boron structure or orthorhombic γ-AlB_{12} type

Space group: $P2_12_12_1$ (γ-AlB_{12} type)

Preparation in [87H2].

lattice parameters
(in Å)

a	16.604(7)	*T* = 300 K	X-ray diffraction	87H1
b	17.551 (6)			87H2
c	10.169(4)			

energy gap
(in eV)

E_g	0.312(5)	*T* = 22 K	deep level to band	94W
	0.326(5)	*T* = 83 K		
	0.315(6)	*T* = 293 K		
	0.576(3)	*T* = 22 K	deep level to band	
	0.576(3)	*T* = 83 K		
	0.567(5)	*T* = 293 K		
	0.730(7)	*T* = 22 K	deep level to band	
	0.727(4)	*T* = 83 K		
	0.709(8)	*T* = 293 K		
	0.997(2)	*T* = 22 K	deep level to band	
	0.982(6)	*T* = 83 K		
	0.873(6)	*T* = 293 K		
	1.625(6)	*T* = 293 K	indirect allowed, phonon absorption	
	1.850(7)	*T* = 22 K	indirect allowed, phonon emission	
	1.831(6)	*T* = 83 K		
	1.779(6)	*T* = 293 K		
	1.864(6)	*T* = 293 K	indirect allowed, phonon absorption	
	1.925(7)	*T* = 22 K	indirect allowed, phonon emission	
	1.905(6)	*T* = 83 K		
	1.919(6)	*T* = 293 K		
	2.007(7)	*T* = 22 K	indirect allowed	
	1.980(6)	*T* = 83 K		
	1.973(6)	*T* = 293 K		

Edge absorption spectrum of $Al_{1.44}Mg_{0.65}B_{22}$ in Fig. 1 [94W]; see also [87G].

microhardness

H_V	2750(160) kg mm^{-2}	*T* = 300 K	87H2

$Al_xCu_yB_{25}$

Structure formula $(B_{12})_4B_2Al_2Cu_{1.58}$

α-tetragonal structure (to be distinguished from $Al_xCu_yB_{105}$ compounds with β-rhombohedral boron structure (see LB III/41C "Boron")

Space group: $P\bar{4}n2$ [85H]; $P4_2/nnm$ [90H].

lattice parameters
(in Å)

a	9.002(3)	*T* = 300 K	$Al_{1.00}Cu_{0.79}B_{25}$, X-ray diffraction	85H
c	5.069(2)			
a	9.02(3)		$Al_{1.3}Cu_{1.1}B_{25,}$ $Al_{1.5}Cu_{0.7}B_{25}$	90H
c	5.08(2)			

occupancies of Al and Cu sites

Al	50 %*)	85H
Cu(1)	76.04 %	
Cu(2)	2.84 %	

*) The Al atoms fully occupy the holes centered at the 2(a) site (0, 0, 0; 1/2, 1/2, 1/2). However the Al site in this hole is split into to positions (0, 0, 0±0.049; 1/2, 1/2, 1/2±0.049).

For thermal ellipsoids, interatomic distances and comparison of the B-B bond lengths with those in related structures see [85H].

References:

85H Higashi, I., Takahashi, Y.: J. Less-Common Met. 108 (1985) 177.

87G Gurin, V.N., Korsukova, M.M., Kuz'ma, Yu.B., Chaban, N.F., Nechitailov, A.A., Haupt, H., Werheit, H.: in: Proc. 9th Int. Symp. Boron, Borides and Rel. Compounds, University of Duisburg, Germany, Sept. 21 - 25, 1987, H. Werheit ed., University of Duisburg: Duisburg, 1987, p. 275.

87H1 Higashi, I., Ito, T.: in: Proc. 9th Int. Symp. Boron, Borides and Rel. Compounds, University of Duisburg, Germany, Sept. 21 - 25, 1987, H. Werheit ed., University of Duisburg: Duisburg, 1987, p. 41.

87H2 Higashi, I., Sida, J., Iimura, Y., Takahashi, Y.: in: Proc. 9th Int. Symp. Boron, Borides and Rel. Compounds, University of Duisburg, Germany, Sept. 21 - 25, 1987, H. Werheit ed., University of Duisburg: Duisburg, 1987, p. 271.

90H Higashi, I., Kobayashi, M., Takahashi, Y.: J. Cryst. Growth 99 (1990) 998.

94W Werheit, H., Krach, G., Kuhlmann, U., Higashi, I., Gurin, V.N., Korsukova, M.M.: Proc. 11th Int. Symp. Boron, Borides and Rel. Compounds, Tsukuba, Japan, August 22 - 26, 1993, Jpn. J. Appl. Phys. Series 10 (1994), p. 96.

Fig. 1.

$Al_{1.44}$ $Mg_{0.65}$ B_{22}. Absorption edge; absorption coefficient α vs. photon energy for T = 22, 83 and 193 K [94W].