

substance: boron compounds, general properties

property: general remarks on structure and chemical bond

The boron compounds and especially the borides show a wide variety of structures and compositions which include single atoms, connected pairs, multiple chains, planar networks and polyhedral groupings which are preferably based on octahedra, icosahedra or even more complex polyhedral structures. This variety is the consequence of the peculiar electronic structure of boron atoms characterized by an unpaired electron in the $2s^2 2p^1$ configuration of the outer electron shell of the isolated boron atom, and leading to the various combinations of $s^2 p$, sp , sp^2 , and sp^3 electron configurations by the electron interchange between boron atoms or by the interaction with electrons of other atoms.

From this point of view according to Serebryakova [79S] the borides can be divided into three classes:

1. Borides formed by elements with s outer electrons and with the deeper electron shells completely occupied or completely unoccupied (borides of the alkaline metals, beryllium, magnesium, alkaline earth metals).
2. Borides formed by elements with s outer electrons and incomplete d or f subshells (borides of the IV to VIII group elements (the transition metals, the rare earths metals and the actinides).
3. Borides formed by elements with s , p outer electrons (e.g. BN, BP).

Each of these classes of borides can be divided into two groups:

- a) Metal-rich borides (compositions like Me_4B , Me_3B , Me_2B , MeB).
- b) Boron-rich borides (compositions like MeB_2 , MeB_6 , MeB_{12} , MeB_{41} , $MeB_{66...100}$).

From lower to higher borides the tendency of the formation of direct B – B bonds with covalent bond character increases leading to the change from metallic conduction of lower borides to semiconduction of higher borides. Nevertheless no general limit between both types of solids with regard to the composition can be indicated [77S1, 77S2, 79S]. On the binding in borides, see also [77S3].

References:

- 77B Berezin, A. A., Golikova, O. A., Zaitsev, V. R., Kazanin, M. M., Orlov, V. M., Tkalenko, E. N.,
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1977, p. 52.
- 77S1 Samsonov, G. V., Kovenskaya, B. A.: see [77B], p. 5.
- 77S2 Samsonov, G. V., Kovenskaya, B. A.: see [77B], p. 19.
- 77S3 Schubert, K.: Chem. Ser. 12 (1977) 109.
- 79S Serebryakova, T.: J. Less-Common Met. 67 (1979) 499.