substance: boron compounds, general properties
property: general remarks on boron compounds

Since the first article on "boron compounds" in Landolt-Börnstein Vol. III/17g appeared in 1984, the investigation of solid state and semiconductor properties of these compounds has been considerably extended, although remaining far from being complete. Meanwhile it is evident that the compounds belonging to the same structure families are not only narrowly related in structure but also related with regard to their physical including their electronic properties. Moreover, the properties of representatives of different structure families are more or less narrowly related as well, at least regarding some specific fundamental properties. For the application of solids such relationships are essential because they facilitate to tailor these materials for specific applications. In the case of those boron compounds, whose structures are essentially determined by icosahedra, some fundamental properties like high melting point, high hardness, high resistance against chemical attack exist even irrespective of their attribution to specific structure families. Hence in the case of these boron compounds the following possibilities to modify specific properties are at disposal without losing the advantage of the fundamental properties.

1. change of the structure family
2. change of the elements of binary compounds within the same structure families
3. variation of the compounds within their sometimes large homogeneity ranges
4. formation of ternary compounds, which often seems merely to be a kind of doping
5. doping by the interstitial accommodation of foreign atoms

In this introduction an overview on the different structure families, which have till now proved to be most important, and their members will be given to show the boron compounds, for which such relationships have been established. Information on properties in this section will be restricted to comparative investigations and results. For the listing of details of properties of single compounds the scheme of the preceding article on boron compounds is largely retained, which means that the binary compounds are arranged according to the periodic table of elements in the sequence of its groups. The ternary compounds, which, at least in many cases, are to be considered as doped binary compounds, are accordingly attributed.

Many of the structure families of boron compounds are attributed to modifications of elementary boron. For properties of elementary boron the reader is referred to "Boron" in Landolt-Börnstein Volume III/41C, where a general discussion of the electronic properties of icosahedral boron-rich solids is given as well.

Comparisons between the polyhedral structures of the solid higher borides and of the molecular boranes, carboranes and metalloderivated boranes are given in [81L].

Compounds of the following types remain generally unconsidered, since they are treated in other chapters of this book, they are no semiconductors, their semiconducting properties seem to be of low interest, or their semiconducting properties are not essentially influenced by their low boron content:

1. $A_{III}B_V$ compounds.
2. Boranes.
3. Borate glasses.
4. Metglasses containing boron.
5. Boron ferrites.

Otherwise completeness has been aimed at. Of course semiconductors are of primary interest, but in many cases an unambiguous separation between semiconducting and metallic boron compounds is not possible for the following reasons:

1. The theoretical considerations and calculations regarding band structures, electronic structures, nature of bonding, atomic coordination and general nature of the formation of boron compounds are quantitatively or even qualitatively uncertain in some cases at present.
2. The conductivity character of the compounds has been determined experimentally not at all or not with sufficient certainty.

3. In many boron compounds impurity atoms decisively influence the conductivity character. Therefore in cases where the purity of the material is not guaranteed a revision of the apparently clarified conductivity character may be useful.

If the temperature is not specified in the table or figure, room temperature can be assumed.

References:

81L Lipscomb, W.N.: J. Less-Common Met. 82 (1981) 1.