SOV/21-59-9-12/25

On the Problem of the Solubility of Boron in Silicon

at a temperature of 1,200° C. The data obtained on the solubility at room temperature are close to the results of Pearson and Bardeen [Ref 6] but differ to a certain extent from the data of Horn [Ref 5]. The paper also shows the existence of a eutetic corresponding to 18 at. per cent of boron at a melting point of 1,370°C. The course of the solubility diagram at a higher content of boron shows the possibility of the existence of one more chemical composition of boron and silicon which probably can be expressed by the formula $B_3Si$ and which melts congruently at temperatures close to 1,700 - 1,800°C. This composition was conditionally called the $\gamma$-phase. Based on the obtained data, a hypothetical form is constructed for the section of the boron-silicon system ranging up to 40 at. per cent of boron (see Graph Nr 2).

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SOV/21-59-9-12/25

On the Problem of the Solubility of Boron in Silicon

There are 2 graphs and 8 references, 4 of which are Soviet, 3 English and 1 unidentified.

ASSOCIATION: Instytut metalokeramiky i spetsial'nykh splaviv AN URSR (Institute of Metal Ceramics and Special Alloys of the AS of UkrSSR)

PRESENTED: By V.N. Svyechnykov, Member, AS UkrSSR

SUBMITTED: April 13, 1959

Card 3/3

66299

15.2220, 5.2400(A)

SOV/136-59-11-10/26

AUTHORS: Paderno, Yu. B., Serebryakova, T.I. and Samsonov, G.V.

TITLE: Production and Some Properties of Hafnium Boride

PERIODICAL: Tsvetnyye metally, 1959, Nr 11, pp 48-50 (USSR)

ABSTRACT: Considerable work has been carried out on titanium and zirconium borides. Little study has been made of hafnium boride, but preliminary investigations show it has even better properties. There is probably only one stable compound - the diboride with $AlB_2$ type structure. It has been obtained by precipitation from the gas phase (Ref. 2.3). In the present work it was produced by the reduction of hafnium oxide by boron or boron carbide in a vacuum furnace. The relation of the free energy with temperature is -

$$\Delta F = 358.2 \times 10^3 - 175.05T$$
$$\Delta F = 91.9 \times 10^3 - 39.1T$$

for reduction by boron carbide and boron respectively. The reduction with carbide takes place at somewhat higher temperatures than with boron. At a pressure

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SOV/136-59-11-10/26

Production and Some Properties of Hafnium Boride

of $10^{-1}$mm mercury at 1300 to 1600°C, chemical analysis showed it was the stoichometric diboride. X-ray analysis showed the cell to be a = 3.137 and c = 3.469 agreeing with the literature. Hot pressing was carried out at 2650° for 5 minutes with a load of 150 kg/cm². The minimum porosity obtained was 15.1%. The electrical resistance of the compound was 8.8 micro ohm/cm agreeing with the literature when porosity is taken into account. The microhardness was 2900-500 kg/mm². At temperatures above 650 to 700°C, an oxide film was formed on the compound. There are 15 references, of which 9 are Soviet, 5 English and 1 German.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR)

Card 2/2

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66650

SOV/21-59-11-10/27

AUTHORS: Samsonov, H.V. and Paderno, Yu.B.

TITLE: Electric Properties of Borides of Rare-Earth Metals

PERIODICAL: Dopovidi Akademiyi nauk Ukrayins'koyi RSR, 1959, Nr 11, pp 1215 - 1218 (USSR)

ABSTRACT: This is an account of a study of the possibility of utilization of hexaborides of alkaline and rare-earth metals as cathodes in electric devices. Furthering the results of studies of this matter contained in books listed in the reference block, the authors investigated the electric resistance and the thermo e.m.f. in hexaborides of lanthanum, cerium, praseodymium, neodymium, samarium and gadolinium. The experiments were conducted in described installations, [Ref 11 and 12], in the region from room temperature to 700-800°C. Measurements were made on samples of powders of respective hexaborides by hot pressing. The results are compiled in a table. It was found that hexaborides are metallic conductors with hole

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SOV/21-59-11-10/27

Electric Properties of Borides of Rare-Earth Metals

conductivity which tallies well with their electronic structure, and that the hexaborides have a resistance less than resistance in metals. In order to obtain thermo-emitters with high resistances, the authors recommend combining borides which greatly differ from one another in congestion of d- and f-electronic levels and have lower values of work function of electrons, especially such combinations of borides as lanthanum-cerium, cerium-gadolinium, cerium-terbium, cerium- lutecium, or a combination of yttrium and scandium borides with lanthanite borides. There are 2 tables and 19 references, 14 of which are Soviet, 2 German and 3 English.

ASSOCIATION: Instytut metalokeramiky i spetssplaviv AN URSR (Institute of Metalloceramics and Special Alloys of the AS UkrSSR)

PRESENTED: By V.M. Svyechnykov, Member, AS UkrSSR

SUBMITTED: January 30, 1959

Card 2/2

SOV/70-4-1-21/26

AUTHORS: Samsonov, G.V., Dzeganovskiy, V.P. and Semashko, I.A.

TITLE: Europium Hexaboride (Geksaborid evropiya)

PERIODICAL: Kristallografiya, 1959, Vol 4, Nr 1, pp 119 - 120 (USSR)

ABSTRACT: $EuB_6$ has hitherto been unexamined. It was synthesised by the reaction $Eu_2O_3 + 3B_4C = 2EuB_6 + 3CO$ in vacuo at 1 650 °C over the course of two hours. X-ray powder photographs were taken of the product which contained less than 0.02% C and was dark grey. The unit cell is cubic with a = 4.163 ± 0.001 kX and space group $O_h^1$, characteristic of all the hexaborides of the rare earths. The X-ray density is 4.99 ± 0.01 g/cm³. The atomic radii of Eu and Yb are greater than those of the other rare earths and their unit cells are correspondingly greater (mostly about 4.14). The work function of $EuB_6$ (for an emission constant of A = 1 000 - 5 000 A/cm²) was found to be 4.90 eV which is higher than that of any other rare-earth hexaboride. It indicates the maximum multiplicity and consequently the greatest binding of the electrons of Eu which has in the normal state 7 electrons

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Europium Hexaboride

SOV/70-4-1-21/26

in the 4f-shell, without the presence of electrons in the 5d-shell; such a 5d-electron in Gd causes a sharp fall in the work function of its hexaboride by comparison with $EuB_6$ ($\varphi_{GdB_6}$ = 2.06 eV). There are 2 figures and 11 references, 7 of which are Soviet, 1 international, 1 English, 1 German and 1 Scandinavian.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Metallo-ceramics and Special Alloys of the Ac.Sc., Ukrainian SSR)

SUBMITTED: August 22, 1958

Card 2/2

SOV/70-4-4-11/34

AUTHORS: Samsonov, G.V., Zhuravlev, N.N., Paderno, Yu.B. and Melik-Adamyan, V.R.

TITLE: The Synthesis and Properties of Samarium Hexaboride

PERIODICAL: Kristallografiya, 1959, Vol 4, Nr 4, pp 538-541 (USSR)

ABSTRACT: $SmB_6$ was prepared by $Sm_2O_3 + 3B_4C = 2SmB_6 + 3CO$, the $Sm_2O_3 + 3B_4C$ being previously heated as powders to ~ 350 °C and pressed into pellets which were heated in vacuo for 1 hour at 1 000 ° and then 10-15 min at 1 600 °C. An alternative method, $Sm_2O_3 + 15B = 2SmB_6 + 3BO$, was also successful. Heating for 1 hour at 1 650 °C gave $SmB_6$ in a finer-grained form than did the $B_4C$ method. $SmB_6$ is dark blue. It was examined in an RKU-114 powder camera and proved to be cubic, with the $CaB_6$ structure and cell size a = 4.128 ± 0.003 Å. Observed and calculated intensities were compared.

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SOV/70-4-4-11/34

The Synthesis and Properties of Samarium Hexaboride

$d_{calc}$ = 4.85 g/cm$^3$. The coefficient of emissivity $\varepsilon_\lambda$ was measured at temperatures between 900 and 1 600 °C and took the form:

$$\log \varepsilon_\lambda = c/\lambda \ (1/T - 1/T_\lambda) ,$$

where c is the emissivity of an absolutely black body, and

λ = 650 mμ, decreasing linearly from 0.75 at 900° to 0.68 at 1 600 °C. The maximum observed density of powder specimens sintered at 2 000 °C was 4.79 g/cm$^3$. The microhardness was 2 500 ± 300 kg/mm$^2$. The electrical resistance was ~388 μΩcm. The thermo e.m.f. was measured between 20 and 700 °C. Between 20 and 60 °C it was found to be 3.4 μV/°C. The melting point under argon was 2 540 °C. The coefficient of thermal expansion from 20 to 800 °C was 6.5 x 10$^{-6}$. The work function was 4.4 eV. These physical

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SOV/70-4-4-11/34

The Synthesis and Properties of Samarium Hexaboride

properties are compared with those of the rare earth hexaborides.

There are 3 figures, 1 table and 7 references, of which 5 are Soviet, 1 German and 1 English.

ASSOCIATIONS: Otdel tugoplavkikh soyedineniy Instituta metallokeramiki i spetsial'nykh splavov AN UkrSSR (Section of Refractory Compounds, Institute of Metallo-ceramics and Special Alloys of the Ac.Sc., Ukrainian SSR
Kafedra fiziki tverdogo tela MGU im. M.V. Lomonosova (Department of Solid-state Physics of Moscow State University imeni M.V. Lomonosov)

SUBMITTED: January 7, 1959

SOV/70-4-4-12/34

AUTHORS: Samsonov, G.V., Paderno, Yu.B. and Serebryakova, T.I.

TITLE: On the Borides of Praesodymium, Erbium and Terbium

PERIODICAL: Kristallografiya, 1959, Vol 4, Nr 4, pp 542-544 (USSR

ABSTRACT: The borides of Pr, Er and Tb were made from the oxides by the reactions:

$$Me_2O_3 + 3B_4C = 2MeB_6 + 3CO$$

and

$$Me_2O_3 + 15B = 2MeB_6 + 3BO$$

which were carried out in an electric resistance furnace under vacuum at 1 500 - 2 000 °C. X-ray powder photographs were taken in a 57.3 mm camera. $PrB_6$ was cubic with a = 4.12 Å. With Er a product identical with $UB_4$ was found, presumably $ErB_4$ with a tetragonal cell with a = 7.08, c = 4.02 Å. On the cooler parts of the furnace a blue film of $ErB_6$ was condensed and has been described earlier (V.S. Neshpor and the author - Ref 8).

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SOV/70-4-4-12/34

On the Borides of Praesodymium, Erbium and Terbium

For Tb, a mixture was obtained: cubic $TbB_6$ with a = 4.11 Å and tetragonal $TbB_4$ with a = 7.13 and c = 4.07 Å. Intensities were calculated to index the pattern unambiguously. Tb may have two electronic configurations, $4f^8 5d^1 6s^2$ or $4f^9 6s^2$ and a choice should be possible on the basis of physical properties. Measurements of the work function for $TbB_6$ gave (for an emission current of 120 A/cm$^2$deg$^2$) $\varphi$ = 3.1 eV, which corresponds to $4f^8 5d^1 6s^2$ and gives a decisive choice. Powder data for the four compounds are tabulated. There are 4 tables and 12 references, of which 6 are Soviet, 2 German, 2 English and 2 French.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN UkrSSR (Institute of Metallo-ceramics and Special Alloys of the Ac.Sc.Ukrainian SSR)

SUBMITTED: December 6, 1958

Card2/2

5.2100

77293
SOV/63-4-6-27/37

AUTHORS: Samsonov, G. V., Obolonchik, V. A., Kulichkina, G. N.

TITLE: Brief Communications. The Fusion Diagram of $KBF_4 \cdot KCl$ System

PERIODICAL: Khimicheskaya nuaka i promyshlennost', 1959, Vol 4, Nr 6, pp 804-805 (USSR)

ABSTRACT: The method of obtaining boron by electrolysis of melts has been least investigated, but it might have industrial value if sufficiently developed technologically. For the electrolysis, a bath containing $B_2O_3$, MgO, and $MgF_2$ was used, and 92% pure boron was obtained at 110°. In the present work, the fusion curve of system $KBF_4$-KCl was investigated. Starting materials were KCl, and $KBF_4$ obtained from borofluoric acid. The thermal analysis was carried out with a Kurnakov pyrometer. Melting was done in platinum

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Brief Communications. The Fusion Diagram of $KBF_4$.KCl System

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SOV/63-4-6-27/37

crucibles. From the results of thermal and chemical analyses (determination of boric acid), a fusion curve of the above system was prepared. A chemical compound having the formula $KCl \cdot 11KBF_4$ (mp 590° ) was detected in the system. The above compound forms a eutectic mixture with $KBF_4$, containing 97.8% of $KBF_4$ (mp 508°). The second eutectic system (mp 471°) contains 87.6% of $KBF_4$ and is formed from $KCl \cdot 11KBF_4$ and KCl. There is 1 figure; 1 table; and 7 references, 4 Soviet, 2 French, 1 U.S. The U.S. reference is: U.S. Patent Nr 2572249, 1949.

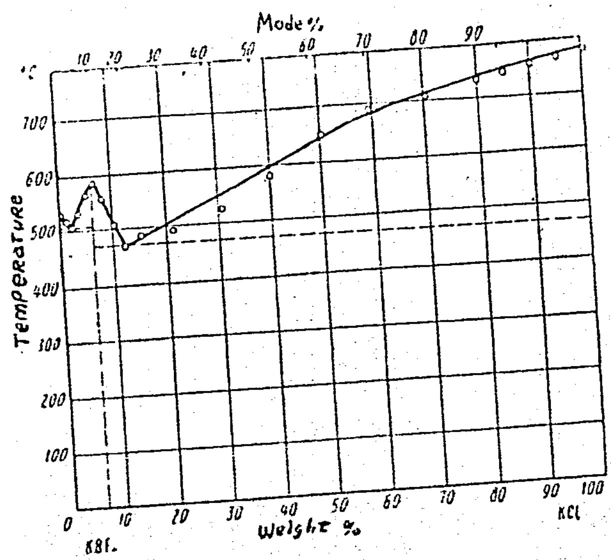
ASSOCIATION: Institute of Cermets and Special Alloys, Academy of Sciences, UkrSSR (Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR)

SUBMITTED: May 29, 1959

Card 2/3

77293
SOV/63-4-6-27/37

Brief Communications. The Fusion Diagram of $KBF_4KCl$ System




Card 3/3

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001447020001-2"

SOV/78-4-9-5/44

5(2)

AUTHORS: Neshpor, V. S., Samsonov, G. V.

TITLE: On the Problem of the Electronic Structure and the Condition for the Formation of Borides of the Type $MeB_6$

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 9, pp 1967-1969 (USSR)

ABSTRACT: The electrons necessary for the formation of the 5 covalent bonds in the hexaborides cannot be supplied by boron alone, two of them must be supplied by the metal (Refs 5, 6). The formation of the hexaborides probably depends on the first and second ionization potentials of the metal. The values of the potentials determine the attractive force of the two valence electrons. In table 1 the ionization potentials of the metallic elements of the periodic system are listed. It is concluded that all the metals having first ionization potentials below 6.6 - 6.8 ev, and second ionization potentials below 11.5 - 12 ev are able to form hexaborides. In reference 8 it was proved that the bivalent metal in the

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SOV/78-4-9-5/44

On the Problem of the Electronic Structure and the Condition for the Formation of Borides of the Type $MeB_6$

hexaboride may partially be substituted by sodium. The highest electron concentration at which this substitution still takes place, is 1.6 electrons per metal atom. Thus, it follows that the bond of the borine in $MeB_6$ requires 1.6 electrons, the remaining 0.4 electrons per metal atom probably being present as common electrons which would explain the comparatively high electrical conductivity of the hexaborides of bivalent metals. There are 1 table and 15 references, 10 of which are Soviet.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR
(Institute for Metal Ceramics and Special Alloys of the Academy of Sciences, UkrSSR)

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SOV/78-4-12-16/35

5 (2)

AUTHORS: Samsonov, G. V., Koval'chenko, M. S., Verkhoglyadova, T. S.

TITLE: Production of Disilicides of Difficultly Fusible Metals

PERIODICAL: Zhurnal neorganicheskoy khimii, 1959, Vol 4, Nr 12, pp 2759 - 2765 (USSR)

ABSTRACT: Pure, finely powdered Ti, Zr, V, Nb, Ta, Cr, Mo, and W were mixed with silicon powder in stoichiometric ratio, pressed into small briquets and annealed in argon atmosphere at 600-1,200° for 0.5-32 hours. The heating took place in an apparatus depicted in figure 1. The reaction products were analytically tested (under the supervision of T. Ya. Kosolapova) and radiographically (RKE and KROS cameras) for free and bound Si. The reaction time needed for the production of completely homogeneous disilicides is given in table 1. There is an exponential relation between reaction temperature and reaction time (Fig 3), which allowed to calculate the activation energy for the diffusion of Si into the metals. The values of this energy are likewise listed in table 1 and compared with the data given in reference 6 for the activation energy during Si diffusion into compact metal. The fact that the activation energy of metallic

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powder is much higher is explained by the crystallization pressure occurring in the formation of disilicide particles which interrupts the contact between metallic and Si particles not yet entered into reaction and complicates diffusion (Refs 7,8). The effect of diffusion-inhibiting oxide films is also likely to be more strongly pronounced in the case of pulverulent mixtures. As a variant, the authors investigated formation of disilicides by vacuum reduction of the metallic oxides according to the formula $Me_xO_y + zSi = Me_xSi_{z-y} + ySiO$ and checked the beginning of the reaction by measuring the pressure which rose as a result of SiO formation. The results obtained for Ti, V, Nb, and Ta are listed in table 3. This method requires a more complicated apparatus and is more difficult to employ in industry than the direct fusion of metal with silicon. Furthermore, it yields less pure products and is inappropriate for metals with volatile oxides (Mo,W). The optimum conditions for a direct reaction between metal and silicon are: $TiSi_2$ 1000 C, 2 hours; $ZrSi_2$ 1000 C, 2 hours; $VSi_2$ 1200 C, 0.5 hours; $NbSi_2$ 1000 C, 0.5 hours; $TaSi_2$ < 1100 C < hours; $CrSi_2$, $MoSi_2$ and $WSi_2$ 1000 C, 0.5 hours.

Production of Disilicides of Difficultly Fusible Metals SOV/78-4-12-16/35

L. M. Khrenova, G. N. Makarenko, and V. P. Dzeganovskiy assisted in the experiments. There are 4 figures, 3 tables, and 11 references, 6 of which are Soviet.

ASSOCIATION: Institut metallokeramiki i spetssplavov Akademii nauk USSR (Institute of Cermets and Special Alloys of the Academy of Sciences, UkrSSR)

SUBMITTED: July 2, 1958

Card 3/3

67696

15.2220
18.6100

SOV/126-8-4-19/22

AUTHORS: Samsonov, G.V., Neshpor, V.S. and Khrenova, L.M.

TITLE: Hardness and Brittleness of Metalloid Compounds

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 4, pp 622-630 (USSR)

ABSTRACT: Specimens of Ti, Zr, Cb, Ta, Cr, Mo, W, Ca, Ba, La and Ce borides and Ti, Zr, Cb, Ta, Cr, Mo, W, Fe, Co and Ni silicides, of limiting phase composition, were made by sintering powders of these compounds by hot pressing with subsequent long annealing at a high temperature in order to remove internal stresses. Microsections made from these specimens were etched in order to expose the grain boundaries and to remove the surface layer which had been cold worked during grinding. The microhardness was tested with a PMT-3 instrument. Loads of 20-200 g were used. The experiments have shown that the microhardness numbers depend on the load used, and this relationship is beyond the limits of accuracy of the measurements. The relationship between microhardness number and load was first established by Bochvar et al (Ref 4) for relatively soft materials (Cu, Zn and Armco iron). In other papers (Refs 5-7) the relationship

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SOV/126-8-4-19/22

Hardness and Brittleness of Metalloid Compounds

estimating the number and nature of cracks and other defects thereby arising. In order to lower the subjectiveness of this estimation a so-called average brittleness mark is introduced, which is calculated according to the degree of destruction shown by the impression. The estimation of the degree of destruction is carried out according to a 5-mark scale (see Fig 5 and Table 1). Figs 6 and 7 show the dependence of the summary mark of destruction of borides and silicides, respectively, on load. Table 2 shows the brittleness characteristics of metalloid compounds. The authors arrive at the following conclusions: The microhardness number depends on the load at which the investigation is carried out. The nature of the relationship between microhardness number and load of materials with very great and comparatively low hardness is identical and appears to be due to the nature of plastic deformation of the surface of hard bodies in microhardness testing. The brittleness characteristics of metalloid compounds obtained by the microbrittleness methods in this work agree satisfactorily

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SOV/126-8-4-19/22

Hardness and Brittleness of Metalloid Compounds.

with those obtained by the author earlier for several compounds. The brittleness of compounds increases with decrease in mean square displacement of molecular complex centres in the crystal lattices of the compounds, i.e. with increase in rigidity in the interatomic bond and with decrease in the possibilities of stress relaxations in the material. The hardness of metalloid compounds increases in the order silicide-nitride-carbide-boride, and the brittleness increases in the order silicide-boride-nitride-carbide.

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There are 7 figures, 2 tables and 18 references, of which 16 are Soviet and 2 English.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Metalloceramics and Special Alloys, Ac. Sc. Ukr.SSR)

SUBMITTED: November 1, 1958

MODYLEVSKAYA, K.D.; SAMSONOV, G.V.

Acid and alkali resistance of the transition metal borides. Ukr. khim.zhur. 25 no.1:55-61 '59. (MIRA 12:4)

1. Institut metallokeramiki i spetssplavov AN USSR.
(Borides)

5(2) SOV/74-28-2-4/5

AUTHOR: Samsonov, G. V., (Kiyev)

TITLE: Borides of Rare Earth Metals (Boridy redkozemel'nykh metallov)

PERIODICAL: Uspekhi khimii, 1959, Vol 28, Nr 2, pp 189-217 (USSR)

ABSTRACT: Borides of rare earth metals have been used in numerous technical fields, above all in the field of electronics, during past years. At present the methods of their synthesis as well as their properties are intensively investigated by Soviet and foreign scientists. Due to the already extensively available material generalizations could be made in the present paper. The structure of borides was investigated by Stackelberg and Neumann (Ref 1) for the first time as well as by Allard in 1932 (Ref 2). Hexaborides of sodium, lanthanum, cerium, praseodymium, neodymium, gadolinium, erbium and ytterbium were investigated. It was determined that all these hexaborides possess a cubic lattice of the type of cerium chloride, which is centered in an octahedron of 6 boron atoms (Fig 1). In one of the first publications, in which the crystallochemistry of borides of alkaline-earth and rare earth metals is elaborated (Ref 6), it is indicated that hexaborides

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SOV/74-28-2-4/5

Borides of Rare Earth Metals

of elements of the II., III., and IV. group of the periodic system are formed. All these hexaborides, with the exception of Be- and Mg-compounds, have a cubic structure of the type $CaB_6$. It was found that in the series of cubic hexaborides there are several sub-groups the place of which is determined by the valence of the metal atom. In the formation of hexaborides the metal atom emits 2 external electrons to boron in order to form 5 hybrids connected orbits, which are formed by s, p, and excited d functions. In so far as the hexaborides do not produce any properties of ion compounds, the emission of electrons to boron takes place as a statistic electron exchange between metal and boron atoms. The analysis of experimental material indicates (Ref 12) that hexaborides are actually formed by those metals only the first ionization potential of which does not exceed 6.6-6.8 ev and the second ionization potential not 11.5-12 ev. The following conditions have to be maintained for the formation of metallic hexaborides: 1) a certain value of the first and second ionization potential which does not exceed the critical values; 2) the presence of bivalent electrons on the ns-level; 3) the

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possibility of a participation of the partly filled or empty (n-1)d-level in the bond metal boron. The existence of 5f-levels is not obligatory, however, they play their part in the formation of hexaborides (Ref 5). In this connection all rare earth metals would have to form hexaborides. This is actually the case. For the present only the prometheum and thulium hexaboride are still unknown. In the earliest publications the metallic conductivity of hexaborides was already determined (Ref 1) and confirmed later on (Refs 1, 4, 5, 20, 21, 22). An exact phenomenological analysis of the variation of the electric resistance of hexaborides of rare earth metals is, at present, complicated since there is a lack of data on the resistance of both hexaborides and metals. All hexaborides of rare earth metals are marked by a poor work function of electrons and some of them by high emission fluxes. Their magnetic properties were investigated on samples obtained from media melted by means of electrolysis (Refs 4, 30) (Table 4). The investigation of the susceptibility course with temperature (Fig 9) has shown an approximate linearity of the susceptibility coefficients at high temperatures and a great deviation of the straight

SOV/74-28-2-4/5

Borides of Rare Earth Metals

lines in the temperature range of 0-350°. This is explained by the presence of ferromagnetic impurities in the preparations. The data on the thermo-electromotive force of hexaborides are given in Table 2. Like borides of transition metals of IV., V., and VI. group of the periodic system borides of Sc, Y and lanthanides are distinguished by high melting temperatures, hardness, moderate thermal expansion coefficients and chemical stability. There are only few data available concerning chemical properties of hexaborides (Refs 28, 37, 42). Borides of rare earth metals can be obtained by different ways: 1) by direct binding of metal with boron; 2) by electrolysis of molten media; 3) by the reduction of mixtures of metallic oxides and boric anhydrides with carbon; 4) by the reaction taking place between metallic oxides and boron carbide or boron mixture and carbon; 5) by the reduction of metallic oxides with boron. The powders of borides are viscous, brittle and not plastic. By the usual way of sintering of pressed briquettes no compact products can be obtained from them (Ref 51). Several conditions for sintering are given in Table 7. Compact products can be obtained from borides by casting (Ref 33). In this case, however, a contamination and

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SOV/74-28-2-4/5

Borides of Rare Earth Metals

coarsening of the structure must be taken into account. In conclusion it may be stated that the properties and production methods of borides of rare earth metals are not yet sufficiently investigated. There are 11 figures, 7 tables, and 72 references, 47 of which are Soviet.

Card 5/5

SAMSONOV, G.V. [Samsonov, H.V.], doktor tekhn. nauk; RADOMYSEL'SKIY, I.D. [Radomysel's'kyi, I.D.], kand. tekhn. nauk

Conference on problems of powder metallurgy. Visnyk AN URSR 30 no.3:71-72 Mr '59. (MIRA 12:6)
(Powder metallurgy—Congresses)

SAMSONOV, G. [Samsonov, H.], kand. tekhn. nauk; PADERNO, V.

International scientific contacts of the Institute of Metallo-Ceramics and Special Alloys of the Academy of Sciences of the Ukrainian S.S.R. Visnyk AN URSR 30 no.7:64-66 Jl '59. (MIRA 12:10)
(Ceramic metals) (Alloys)

SAMSONOV, G.V.

Some important fields of use for rare earth compounds. TSvet. met. 32 no.2:58-59 F '59. (MIRA 12:2)
(Rare earth compounds)

21(1) SOV/20-125-2-20/64

AUTHORS: Paderno, Yu. B., Serebryakova, T. I.
Samsonov, G. V.

TITLE: The Compounds of Terbium With Boron and the Electron Configuration of the Atom of Terbium (Soyedineniya terbiya s borom i elektronnaya konfiguratsiya atoma terbiya)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 2, pp 317-318 (USSR)

ABSTRACT: Hitherto, the compounds of nearly all rare-earth metals with boron, with the exception of promethium, terbium, and thulium, are known and have been sufficiently well investigated. Among them, the compounds of terbium with boron are of special interest because of the 2 possible variants of the electron structure of the terbium atom (which are described by the configurations $4f^8 5d^1 6s^2$ or $4f^9 6s^2$). The terbium- and boron compounds were produced by the reduction of terbium oxide by boron carbide $Tb_2O_3 + 3B_4C = 2\ TbB_6 + 3\ CO$ and by boron $Tb_2O_3 + 15B = 2TbB_6 + 3BO$ in accordance with previously

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The Compounds of Terbium With Boron and the Electron Configuration of the Atom of Terbium SOV/20-125-2-20/64

described methods (Refs 3, 4). In both cases the reduction took 1 hour at 1650°. The reduction with boron resulted in a blue-colored product, and its X-ray picture is characteristic of the hexaborides of the rare-earth metals with cubic lattice of the structural type $O_h^1$. According to the results obtained by calculating the intensities of X-ray reflections, this product was found to be terbium-hexaboride with the lattice period a = 4.11 Å. Reduction of the terbium oxide by boron carbide gave a greyish-brown product, viz. $TbB_4$ with the identity periods a = 7.13 Å and c = 4.07 Å of the tetragonal lattice. The work function of the electrons in the thermoemission from $TbB_6$ is $\varphi$ = 3.1 ev and was determined by V. A. Trigubenko and B. M. Tsarev. This value corresponds to the dependence of the work function of the borides on the ordinal number of the rare-earth metals, which had been determined previously (Ref 2) assuming the electron structure

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The Compounds of Terbium With Boron and the Electron Configuration of the Atom of Terbium SOV/20-125-2-20/64

$4f^8 5d^1 6s^2$ of terbium. Thus, of the initially mentioned two structures, the last-mentioned is uniquely confirmed. The existence of the fsd - electron configuration indicates a considerable degree of binding of the electrons of terbium and boron in the sd-band of the hexaboride lattice. The existence of the borides $TbB_4$ and $TbB_6$ and their crystallo-chemical characteristics were for the first time determined by the authors. There are 2 tables and 6 references, 5 of which are Soviet.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR (Institute of Metal Ceramics and Special Alloys of the Academy of Sciences, UkrSSR)

PRESENTED: December 9, 1958 by S. A. Vekshinskiy, Academician

SUBMITTED: December 8, 1958

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SOV/20-125-4-37/74

5(2)

AUTHORS: Portnoy, K. I., Samsonov, G. V., Solonnikova, L. A.

TITLE: On the Interaction of Boron Carbide With Silicon (K voprosu o vzaimodeystvii karbida bora s kremniyem)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 125, Nr 4, pp 823-825 (USSR)

ABSTRACT: The system boron-silicon-carbon is interesting because of its considerable hardness, its chemical stability and its semi-conductor-properties. In the system boron-carbon e.g. the compounds $B_4C$ and $B_{6.5}C$ (hardness 5000-5500 kg/mm$^2$, Refs 1, 2) are found, in the system silicon-carbon the SiC-compounds with a hardness of 3350 kg/mm$^2$ (Ref 3); the boron-silicon-system contains also compounds with similar properties (Ref 4). After a survey of publications (Refs 5-8) the authors discuss the results they had achieved. They pressed mixtures of silicon and boron carbide powder at 1700-2350° for 1.5 - 8 minutes. In this connection part of the silicon volatilized. A clearly marked maximum of the specific weight was pycnometrically determined, i.e. at 25-30 % by weight of Si. Figure 1 shows the microstructures typical of the alloys investigated. Already

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at an addition of 2% Si to boron carbide a lighter colored phase forms (Fig 1b). The amount of this phase varies only little up to a 20% Si-content, whereas in the case of 28% Si it increases considerably (Fig 1v). In the latter casethe micro-hardness attains 2000 kg/mm$^2$. It remains practically constant in the case of further Si-increase (Fig 2a). This phase is apparently a saturated solid solution of boron and carbon (or boron carbide) in silicon. In the case of 25% Si the micro-structure shows clear separations of the chemical compound (Fig 1g). The hardness of the second phase increases with increasing silicon-content in the alloy and attains a maximum of ~ 7000 kg/mm$^2$ in the case of an Si-content of 40-50% by weight. It then decreases to 3500-4000 kg/mm$^2$ (Fig 2b). From 50% silicon onwards a fine-grained eutectic becomes visible between the grains of the silicon- and carbide phase (up to 80% Si-content in the alloy). On an addition of 20% Si to boron carbide the X-ray investigation shows the appearing lines of a new phase. They are most clear at 35-40% Si; at 50-70% Si they pass over into the lines of the solid solution of boron and carbon in silicon, which are well marked at 75% Si (Fig 3). The maximum of electric resistance of the samples is attained at 28-35% Si in the alloys. From the above it is possible to draw a conclusion on the formation of a ternary phase of boron with silicon and carbon which may have the composition $B_5SiC_2$. Its hardness of ~7000 $kg/mm^2$ explains its high grinding capacity (Ref 9). This phase has a constant resistivity to oxidation in air, at least up to 1200°, to mineral acids and their mixtures also in the case of boiling. There are 3 figures and 9 references, 5 of which are Soviet.

ASSOCIATION: Vsesoyuznyy institut aviatsionnykh materialov (All-Union Institute of Aviation Material). Institut metallokeramiki i spetssplavov Akademii nauk SSSR (Institute of Powder Metallurgy and Special Alloys of the Academy of Sciences USSR)

PRESENTED: December 16, 1958, by A. A. Bochvar, Academician

SUBMITTED: December 16, 1958

PHASE I BOOK EXPLOITATION SOV/4347

Akademiya nauk Ukrainskoy SSR. Institut metallokeramiki i spetsial'nykh splavov. Seminar po zharostoykim materialam

Trudy, vyp. no. 5 (Transactions of the Academy of Sciences, Ukrainian SSR, Institute of Metal Ceramics and Special Alloys, Seminar on Heat Resistant Materials, No. 5) Kiyev, Izd-vo AN Ukrainskoy SSR, 1960. 63 p. 2,000 copies printed.

Ed. of Publishing House: I.V. Kisina; Tech. Ed.: A.A. Matveychuk; Editorial Board: G.V. Samsonov (Resp. Ed.), I.N. Frantsevich, V.V. Grigor'yeva, A.Z. Men'shikov, and M.I. Korsunskiy.

PURPOSE: The book is intended for engineers, scientific workers and students specializing in refractory metals and their compounds, powder metallurgy, electronics, machine building and physical metallurgy in schools of higher technical education.

COVERAGE: This collection of papers, originally presented at the Seminar on Heat Resistant Materials in Kiyev on June 13-June 17, 1958,

discusses the physical properties and production technology of refractory metals and their metal-like compounds with boron, carbon, nitrogen, and silicon. The results of investigations of the absorption and emission spectra of niobium and chromium compounds, processes of joint diffusion of two elements in metals, and data on phenomenological studies of physical properties of metal-like phases are presented. Methods of processing rare metals and refractory compounds in making powders and various articles used in many fields of modern technology are analyzed in detail. Several articles discuss the particular problems of powder metallurgy of ordinary metals and alloys. The papers reflect work performed at the following institutions: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Metal Ceramics and Special Alloys, Academy of Sciences UkrSSR), Gosudarstvennyy institut prikladnoy khimii (State Institute of Applied Chemistry) Leningrad, Khar'kovskiy politekhnicheskiy institut (Khar'kov Polytechnic Institute), Institut fiziki metallov AN SSSR (Institute of the Physics of Metals, Academy of Sciences USSR), Sverdlovskiy gosudarstvennyy universitet (Sverdlovsk State University), VIAM, TsNIICHERMET, VNIIEh, Institut metallurgii AN USSR (Institute of Metallurgy, Academy of Sciences UkrSSR) VNIITS, NIIGRM, MKTS, Gor'kovskiy politekhnicheskiy institut (Gor'kiy Polytechnic Institute), and Moskovskiy elektrolampovyy zavod (Moscow Electric Bulb Plant). References accompany individual articles.

Semenov, S.A., and A.Z. Men'shikov. Kβ Spectra of Chromium Absorption in Borides, Carbides, Nitrides, and Some Other Compounds 21
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Frantsevich, I.N., and A.N. Pilyankevich. Comparative Brittleness of Refractory Compounds 28
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Kudryavtsev, V.I., and G.V. Sofronov. Precision Determination of Lattice Intervals of Boron Carbide of $B_{2.75}C$--$B_{4.75}C$ Composition According to Roentgenograms Obtained in the Region of Large Scattering Angles (0→90°) 52
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Samsonov, G.V.

SAMSONOV, G.V.

SOV/4874

PHASE I BOOK EXPLOITATION

Rakovskiy, Valentin Sergeyevich, Grigoriy Valentinovich Samsonov, and Iosif Ivanovich Ol'khov

Osnovy proizvodstva tverdykh splavov (Fundamentals of Carbide-Alloy Production) Moscow, Metallurgizdat, 1960. 232 p. Errata slip inserted. 5,200 copies printed.

Ed.: A. K. Natanson; Ed. of Publishing House: M. S. Arkhangel'skaya; Tech. Ed.: P. G. Islent'yeva.

PURPOSE: This textbook is intended for students of nonferrous metallurgy tekhnikums, and engineers and technicians in the hard-alloy industry.

COVERAGE: The handbook was written in accordance with the course entitled "The Production of Hard Alloys," taught at tekhnikums specializing in nonferrous metals. It contains the fundamentals of powder metallurgy, manufacturing processes of all types of carbide alloys, characteristics of their properties, and inspection methods. The last section is devoted to the fundamentals of degree design projects. This book is

Card 1/9

SOV/5227

PHASE I BOOK EXPLOITATION

Samsonov, Grigoriy Valentinovich [Professor, Doctor of Technical Sciences], Lev Yakovlevich Markovskiy [Candidate of Chemical Sciences], Aleksey Fomich Zhigach [Doctor of Chemical Sciences], and Mikhail Georgiyevich Valyashko [Doctor of Chemical Sciences]

Bor, yego soyedineniya i splavy (Boron, Its Compounds and Alloys) Kiyev, Izd-vo AN UkrSSR, 1960. 589 p. 3,000 copies printed.

Sponsoring Agency: Akademiya nauk Ukrainskoy SSR. Institut metallokeramiki i spetsial'nykh splavov.

Ed. (Title page): G. V. Samsonov, Professor, Doctor of Technical Sciences; Resp. Ed.: I. N. Frantsevich, Corresponding Member of the Academy of Sciences UkrSSR; Ed. of Publishing House: Z. S. Pokrovskaya; Tech. Ed.: V. Ye. Sklyarova.

PURPOSE: This book is intended for scientific workers and engineers in the metallurgical, machine building, chemical, and electronic industries. It may also be used by advanced students.

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SOV/5227

Boron, Its Compounds and Alloys

COVERAGE: The book describes the principles of boron geochemistry, boron stock and its processing, and the properties, production, and use of elementary boron, boron hydrides, and halogens. It also includes data on the properties, production methods, metal science, and crystal chemistry of boron alloys with metals and nonmetals. All known systems with boron are investigated and applications of boron alloys in the manufacture of fireproof alloys, in electronics and radio engineering, machine building, metallurgy, and chemistry are discussed. Corresponding Member A. V. Nikolayev, G. V. Samsonov, and Ya. S. Umanskiy are cited among the contributors to boron research in the Soviet Union. The authors thank the Scientific Council of the Institut metallokeramiki i spetsial'nykh splavov (Institute of Metal Ceramics and Special Alloys), Academy of Sciences, Ukrainskaya SSR. They also thank Professor Yu. V. Morachevskiy. Most of the chapters are accompanied by references.

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PHASE I BOOK EXPLOITATION SOV/4164

Vsesoyuznoye soveshchaniye po splavam redkikh metallov. 1st, Moscow, 1957

Redkiye metally i splavy; trudy... (Rare Metals and Alloys; Transactions of the First All-Union Conference on Rare-Metal Alloys) Moscow, Metallurgizdat, 1960. 438 p. 3,150 copies printed.

Sponsoring Agencies: Akademiya nauk SSSR. Institut metallurgii; USSR Komissiya po redkim metallam pri nauchno-tekhnicheskom komitete.

Ed.: I.K. Shapovalov; Ed. of Publishing House: O.M. Kamayeva; Tech. Ed.: P.G. Islent'yeva.

PURPOSE: This collection of articles is intended for metallurgical engineers, physicists, and workers in the machine-building and radio-engineering industries. It may also be used by students of schools of higher education.

COVERAGE: The collection contains technical papers which were presented and discussed at the First All-Union Conference on Rare-Metal Alloys, held in the Institute of Metallurgy, Academy of Sciences USSR in November 1957. Results of investigations of rare-metal alloys, titanium, and copper-base alloys with additions of rare metals are presented and discussed along with investigations of rhenium, vanadium, niobium, and their alloys. The effect of rare-earth metals on properties of magnesium alloys and steels is analyzed. The uses of rhenium as a dehydrating catalyst, electroplating material, and material suitable for making plugs for automobile electrical systems are discussed. Also, the effect of the addition of certain elements on the properties of heat-resistant steel is examined and alloys with special physical properties (particularly semiconductive alloys) are discussed. No personalities are mentioned. Soviet and non-Soviet references accompany some of the articles.

PART II. TITANIUM, AND COPPER-BASE ALLOYS WITH RARE-METAL ADDITIONS

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Rare Metals (Cont.)

PART VI. ALLOYS WITH SPECIAL PHYSICAL PROPERTIES


Zhdanov, G.S., N.N. Zhuravlev, A.A. Stepanova, and M.M. Umanskiy. X-ray Analysis of Compounds of Boron With Rare Metals 366

Zhuravlev, N.N., T.A. Mingazin, and G.S. Zhdanov. Investigation of Superconductive Bismuth-Rubidium and of Bismuth-Cesium Alloys 372

Bol'shanina, M.A., T.P. Yelsukova and P.A. Kondrat'yev. The Use of Tellurium in the Cable Industry 381

Samsonov, G.V., and V.S. Neshpor. Alloys of Rare Metals With Boron and Silicon [Used] For Certain Radio and Electrotechnical Purposes 392

Abrikosov, N.Kh. Rare Elements in Semiconductive Materials 418

Kokina, N.G. New Photocathodes for Ultraviolet Irradiation Gaging, Made From Alloys of Magnesium With Rare Metals 428


PART VII. RESOLUTION

AVAILABLE: Library of Congress

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10/14/60

(14)

Samsonov, G.V.

27992
S/194/61/000/004/035/052
D266/D302

15.2640

AUTHOR: Samsonov, G.V. and Neshpor, V.S.

TITLE: Alloys of rare metals with bor and silicon for some purposes of electrical and radioengineering

PERIODICAL: Referativnyy zhurnal. Avtomatika i radioelektronika, no. 4, 1961, 3, abstract 4 G15 (V sb. Redk. metally i splavy, M., Metallurgizdat, 1960, 392-417)

TEXT: The conditions of obtaining silicides and borides of rare metals are investigated and their physical properties are studied for possible application. The silicides are obtained by heating the mixture of the components in powdered form at a pressure of 250 kg/cm$^2$ and at a temperature of 1300-2150°C. The synthesis of the borides is carried out by utilizing the interaction of metal oxides with boroncarbide and carbon in vacuum. The structure of the obtained alloys is investigated and their crystal structure is determined. The hexaborides are distinguished by their low work

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Alloys of rare metals...

function and slow evaporation which shows the prospect of using them as thermionic emitters. Their disadvantage is the small electrical resistance which makes their heating difficult. This property can be considerably improved by dissolving ceriumboride in them which leads to a solid solution of high electric resistance preserving the thermoelectric properties of the original borides. [Abstracter's note: Complete translation]

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18.600

77160
SOV/129-60-1-8/22

AUTHOR: Samsonov, G. V. (Professor, Doctor of Technical Sciences)

TITLE: Sintering of Tungsten-Titanium-Cobalt Hard Alloy in Vacuum

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, Nr 1, pp 25-27 (USSR)

ABSTRACT: The influence of temperature and the duration of sintering on the degree of cobalt volatilization as well as the effect of free carbon on sintering process of tungsten-titanium carbide T15K6 process were investigated. The powders of the following chemical composition were used: Nr 1-12.21% Ti; 6.34% Co; 7.51% C,total; 0.05% C. free; 0.41% O. Nr 2-13% Ti; 7.48% C, total;6.55% Co;0.05% C, free; 0.28% O; 0.0075% Fe. Samples were heated in a vacuum furnace at 1,550° C for 15, 30, 60, and 120 min under pressures of 0.1; 1; 10 and 100 mm Hg. After heating, the samples were ground to

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Sintering of Tungsten-Titanium-Cobalt Hard Alloy in Vacuum

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powder and the content of cobalt was determined. The decreasing of cobalt content during sintering at different pressures is shown in Fig. 1.

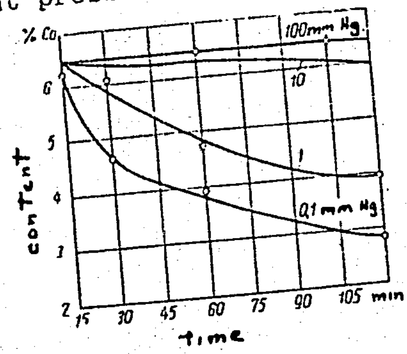


Fig. 1.
The decreasing of cobalt content in carbide T15K6 during sintering at 1,550° C in a vacuum furnace.

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Sintering of Tungsten-Titanium-Cobalt Hard Alloy in Vacuum

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The following conclusions were drawn: For preventing volatilization of cobalt during sintering carbide T15K in vacuum, the pressure in the furnace must not be below 10 mm Hg. With this pressure and a temperature of 1,400° C the structure formation of the carbide is completed within 12 hours. The carbide has high physical and mechanical properties and no porosity. In the atmosphere of hydrogen and at 1,550° C, sintering lasts 3 to 4 hr. The addition of carbon to the initial material improves microstructure and physical and mechanical properties. However, as seen from Table 2, large additions of carbon impair the properties and prolong the sintering process.

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Sintering of Tungsten-Titanium-Cobalt Hard Alloy in Vacuum

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Table 2

Relationship between the properties of carbide sintered in vacuum and the free carbon content in the mixture.

| $C_{free}$ content % | Specific Gravity | Hardness Rc |
|---|---|---|
| 0,05 | 11,26 | 91,2 |
| 0,1 | 11,31 | 90,9 |
| 0,2 | 11,43 | 90,7 |
| 0,5 | 11,23 | 90 |
| 1 | 11,05 | 90 |
| 1,5 | 10,54 | 89,7 |

There are 2 tables; and 2 figures.

ASSOCIATION: Institute of Metalloceramics and special alloys AS UkrSSR

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4

SAMSONOV, G. V.

77162
SOV/129-60-1-10/22

18.6000

AUTHORS: Babich, B. N. (Engineer), Portnoy, K. I. (Candidate of Technical Sciences), Samsonov, G. V. (Professor, Doctor of Technical Sciences)

TITLE: Pressing and Sintering of Boride Powders

PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov, 1960, Nr 1, pp 31-35 (USSR)

ABSTRACT: The first investigation of the processes of pressing powders of various compositions was carried out in earlier work (Samsonov, G. V., Neshpor, V. S., D.A.N. SSSR, Vol 104, 1955). Later on G. A. Meerson developed a theory of sintering for plastic metals. In this work the authors investigate the pressing and sintering of (1) titanium and chromium boride powders, and (2) titanium and chromium boride alloys (ratio of molar concentration $TiB_2:CrB_2 = 4:1$). The initial titanium and boride powders were prepared by the thermal-vacuum method, and double titanium-chromium boride by homogenization of these boride

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mixtures at 1,700° C for 1 hr in a vacuum. The size of particles of all three powders ranged between 2 and 3 micron. The weight of 1 ml of powders $TiB_2$, $CrB_2$, $(Ti,Cr)B_2$ is (in grams) 0.80, 1.05, 0.97, respectively.

Pressing: The method of investigating the process of pressing consists in studying the effect of holding under pressure on density of compressed briquettes, measuring the elastic aftereffect, and studying the effect on density of intermediate grating of compressed briquettes. None of the tested plasticizers markedly improved the pressibility of briquettes, although briquette strength was at a maximum when using $FeCl_3$ solution. Fig. 1 shows the results of pressing depending on compacting pressure. The data show that $TiB_2$ is endowed with the best pressibility.

Pressing and Sintering of Boride Powders

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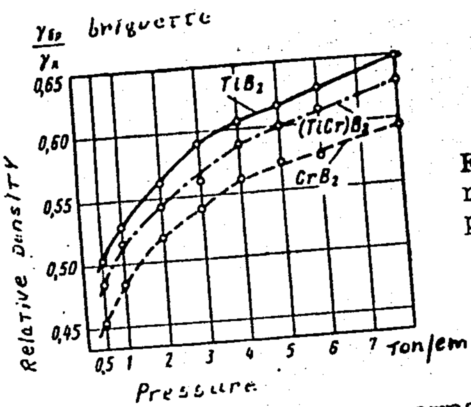


Fig. 1. Correlation between relative density and compacting pressure.

Fig. 2 shows a compacting pressure diagram in logarithmic coordinates $\log p_{sp} - \log \beta$, where $\beta$ is relative volume $\beta = \frac{\gamma_{compact}}{\gamma_{briquette}}$, showing that

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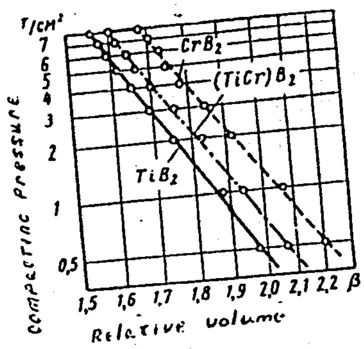


Fig. 2. Correlation between relative volume and compacting pressure.

the process of pressing is well expressed in straight lines. For $TiB_2$ $\log p_{sp} = -11.07 \log \beta + 3.02$; for $CrB_2$ $\log p_{sp} = -10.48 \log \beta + 3.25$; for $(TiCr)B_2$ $\log p_{sp} = -11.29 \log \beta + 3.24$ ($p_{sp}$ = specific pressure). The authors conclude that the process of compacting titanium, chromium and titanium boride solid solution powders is described by the logarithmic relationship between relative volume and compacting pressure. Results of determining the elastic aftereffect are shown in Fig. 3. The elastic aftereffect

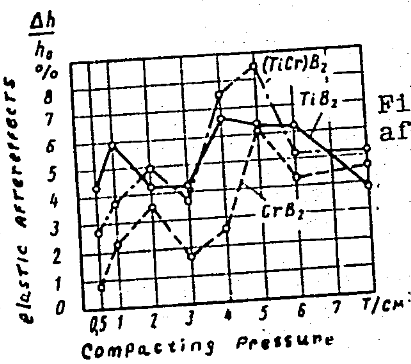


Fig. 3. Relationship between elastic aftereffect and compacting pressure.

of the investigated materials is of major importance since the character of the relationship of aftereffect and pressure is connected with high brittleness and nonplasticity of borides. Sintering: In order to observe sintering conditions, the briquettes were compacted under a pressure of 3 ton/cm$^2$ and sintered in a vacuum (0.1 mm Hg) in a retort furnace with a graphite heater. To determine the optimum sintering temperature the specimens were sintered within the 1,700-2,400° C range for 1 hr. It was found that the sintering process occurs in two stages: (1) minor density increase at maximum temperatures up to 2,100-2,200° C; and (2) intensive density increase above these temperatures. $TiB_2$ boride and solid solution $(Ti,Cr)B_2$ were held at 2,300° C while $CrB_2$ was held at 2,000° C: The maximum density was obtained at a holding time of 120 min. As a result, the process of compacting boride briquettes in sintering consists in drawing particles into the pore space at temperatures of the second stage of sintering at which the forces of surface tension

Pressing and Sintering of Boride Powders

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SOV/129-60-1-10/22

predominate over the strength of the particles which became plastic. The investigation shows the possibility of pressing and sintering separately, instead of using the complex and expensive method of hot pressing. There are 3 figures; 3 tables; and 12 references, 10 Soviet, 1 U.S., 1 German. The U.S. reference is: Chiotti, P., "J. Amer. Cer. Soc.", Vol 35, 1952.

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S/131/60/000/01/011/017
B015/B001

15(2)

AUTHORS: Samsonov, G. V., Yasinskaya, G.A., Tay Shou-vey

TITLE: Crucibles of Difficultly Fusible Carbides, Borides, and Nitrides

PERIODICAL: Ogneupory, 1960, Nr 1, pp 35 - 38 (USSR)

ABSTRACT: In this paper, the authors mention the results of the experimental use of the above crucibles for the melting of metals. Figure 1 shows the scheme of the mold for hot-pressing the crucibles, and figure 2 the finished crucibles. The experimental results are shown in the table. Crucibles of TiC, TiN, $TiB_2$, $TiB_2$ + 5% Mo, and $CrB_2$ were investigated. The interaction between the crucible materials and the molten metals and slags, respectively, can be seen on microphotographs (Figs 3 and 4). The experiments showed that all crucibles are sufficiently stable to the effect of molten tin, bismuth, cadmium, and lead. Crucibles of chromic boride and of the alloy of $TiB_2$ with molybdenum are stable to the effect of molten carbon steel and cast iron. Crucibles of

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Crucibles of Difficultly Fusible Carbides, Borides, and Nitrides

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B015/B001

titanium carbide are the most stable to the effect of slags. There are 4 figures, 1 table, and 5 Soviet references.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Powder Metallurgy and Special Alloys of the Academy of Sciences of the Ukrainskaya SSR). Institut metallov AN KNR (Institute of Metals of the Academy of Sciences of the People's Republic of China)

Card 2/2

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S/021/60/000/001/008/013
A158/A029

17.4310 also 2308

26.1300

AUTHORS: Tay Shou-Vey; Yasyns'ka, H.A.; Samsonov, H.V.

TITLE: Interaction of Chromium Boride With Molybdenum

PERIODICAL: Dopovidi Akademiyi nauk Ukrayinskoyi Radyans'koyi Sotsialistychnoyi Respubliky, 1960, No. 1, pp. 48 - 50

TEXT: Properties of alloys in a pseudo-binary system $CrB_2$-Mo were investigated by means of metallographic, thermal and dilatometric analyses, measurement of shrinkage during sintering, electrical resistance and thermal emf. Alloys were made from powdered chromium boride containing 69.88% of Cr, 29.7% of B and 0.42% of C; powdered molybdenum had a 99.98% purity. The melting curve (Fig. 1) was drawn upon the results observed at melting samples pressed from $CrB_2$ and Mo powders, that contained 0.5, 1, 2, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 98, 99, 99.5 and 100 molecular % (or atomic %) of each component, when they were heated up to 1,400 - 2,200°C. Maximum electrical resistance was found in alloys containing 70 molecular % of $CrB_2$ (107 microohms per cm). The same alloys showed the highest thermal emf (7 mkv/degree) and the highest negative shrinkage at sintering. A new chemical compound $Cr_2MoB_4$ was found which melted congruently

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A158/A029

Interaction of Chromium Boride With Molybdenum

at 2,270°C. Its microhardness (in alloys containing from 30 to 90 molecular % of $CrB_2$) is constant at a value of 1,828 ± 92 kg/mm². The diagram of a pseudo-binary system $CrB_2$-Mo is eutectical, with two eutectics at 17 molecular % of $CrB_2$ (1,960°C) and 94 molecular % of $CrB_2$ (~2,120°C), and little mutual solubility of the components in a solid state. There are 2 figures and 4 references: 3 Soviet and 1 English.

ASSOCIATION: Instytut metalokeramiky i spetsial'nykh splaviv AN UkrSSR (Institute of Metalloceramics and Special Alloys, AS UkrSSR)

PRESENTED: by V.M. Svyechnykov, Academician of the AS UkrSSR

SUBMITTED: April 16, 1959

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S/180/60/000/02/017/028
E111/E152

AUTHORS: Koval'chenko, M.S., Samsonov, G.V., and Yasinskaya, G.A. (Kiyev)

TITLE: Alloys of Transition-Element Borides with Other Metals

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Metallurgiya i toplivo, 1960, Nr 2, pp 115-119 (USSR)

ABSTRACT: The high brittleness of transition-metal borides limits the application (Ref 3) of some of their useful properties (Refs 1, 2). The authors suggest that it is therefore important to study their pseudo-binary alloys with ductile metals. Creep tests at 1000 °C (Ref 4) showed that few metals were suitable for high-temperature use. Ternary boride phases, which might be advantageous (Ref 5), have not been studied much (Refs 6-8). In the present work the reaction of borides with metals in the pseudo-binary systems was: $ZrB_2$-Mo, $TiB_2$-Mo, $CrB_2$-Mo, $TiB_2$-Cr and $ZrB_2$-Cr. Alloys were prepared by sintering the mixed powders. Approximate determination of liquidus lines was made visually (Ref 10), alloy melting points also being determined (Ref 11) to fix its position more precisely,

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Alloys of Transition-Element Borides with Other Metals

In addition micro- and macro-hardness determinations of phases were made together with metallographic and X-ray examinations. The hypotectic diagrams for the above systems are given in Figs 1, 2, 3, 4 and 5 respectively. Tay Shou-bey of the Institut Metallov AN KNR (Institute of Metals Academy of Sciences CPR), G.N. Makarenko and V.I. Kostikov participated in the experimental work. There are 5 figures and 12 references, of which 8 are Soviet and 4 English.

Card 2/2

SAMSONOV, G.V.

Making ferroboron from colemanite by the out-of-furnace aluminothermic process. Vop. por. met. i prochn. mat. no.8:8-23 '60. (MIRA 13:8)

(Iron-Boron alloys--Metallurgy)
(Aluminothermy)

28311 S/081/61/000/016/018/040
B143/B101

5-2410

AUTHORS: Samsonov, G. V., Paderno, Yu. B., Fomenko, V. S.

TITLE: Production and some properties of neodymium hexaboride

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 16, 1961, 87, abstract 16B5 (Sb. "Vopr. poroshk. metallurgii i prochnosti materialov", Kiyev, AN USSR, no. 8, 1960, 66 - 68)

TEXT: Two methods of $NdB_6$ production by means of the reactions $Nd_2O_3 + 3B_4C \longrightarrow 2NdB_6 + 3CO$ and $Nd_2O_3 + 15B \longrightarrow 2NdB_6 + 3BO$ were described. In both cases the process took place in a vacuum furnace with graphite heater in the temperature interval 1100 - 1800°C, with permanent removal of the gaseous reaction products. The completeness of the reaction was checked by X-ray pictures and analytically as well as according to the yield. In both cases the holding time for the optimum production process of $NdB_6$ at 1600 - 1650°C is one hour. $NdB_6$ is a finely disperse dark blue powder, the parameter of the crystal lattice is a = 4.124 Å. Compact $NdB_6$

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B143/B101

Production and some...

is obtained from powder by the method of hot pressing. The optimum holding time was 15 - 20 min at 2000°C at a pressure of 175 - 200 kg/cm$^2$. In this case minimum porosity of the compact $NdB_6$ was 3%. The resistivity of $NdB_6$ is 28 μohm·cm. Studies of the thermoelectromotive force of $NdB_6$ paired as a thermocouple with Pt in the interval 20 - 700°C gave a negative value of the coefficient of thermoelectromotive force whose absolute amount slightly increases with increasing temperature. The radiation coefficient of $NdB_6$ is 0.7 (at 1600°C). The microhardness of $NdB_6$ at an indentor load of 70 g was 2540 ± 170 kg/mm$^2$, the melting temperature of $NdB_6$ was 2540°C. The work function of the electrons in thermionic emission is 3.97 ev. [Abstracter's note: Complete translation.]

Card 2/2

27756
S/058/61/000/007/054/086
A001/A101

15.2660

AUTHORS: Samsonov, G.V., Neshpor, V.S.

TITLE: On the problem of magnetic properties of metal-like compounds

PERIODICAL: Referativnyy zhurnal. Fizika, no. 7, 1961, 282, abstract 7E472 (V sb. "Vopr. poroshk. metallurgii i prochnosti materialov", no. 8, Kiyev, AN UkrSSR, 1960, 90 - 98)

TEXT: The results of investigating magnetic properties of compounds of transition elements with C, N, B and Si make it possible to judge on the nature of interatomic bonds in these compounds. The data known in literature on molecular susceptibility $\varkappa_m$ and magnetic moment $\mu_{ef}$ of metallic ions are presented. The $\varkappa_m$ and $\mu_{ef}$ values of the studied compounds, reduced in comparison with the values of the pure metals, indicate the formation in these compounds of a collective of electrons filling the overlapped dsp- band in the crystal. The reduction degree of $\varkappa_m$ is related to the ionization potential magnitude of the metalloid. In the case of hexaborides of rare earths there is no decrease of $\varkappa_m$,

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A001/A101



since the incomplete 4f-shell is screened by outer 6s- and 5d-electrons. The data are presented on temperature dependence of $\varkappa_m$ in hexaborides of rare earths, as well as on the concentration dependence of $\varkappa_m$ for some carbides, borides and nitrides.

L. Boyarskiy

[Abstracter's note: Complete translation]

SAMSONOV, G.V.

Electronic structure and properties of nitrides of high-melting metals. Zhur. strukt. khim. 1 no. 4:447-452 N-D '60. (MIRA 14:2)

1. Institut metallokeramiki i spetsial'nykh splavov AN USSR, Kiyev. (Nitrides)

SAMSONOV, G.V.; ZHURAVLEV, N.N.; PADERNO, Yu.B.; SHULISHOVA, O.I.
SEREBRYAKOVA, T.I.

Interaction of gallium, indium, thallium, germanium, tin, and lead with boron. Zhur. strukt. khim. 1 no. 4:458-463 N-D '60. (MIRA 14:2)

1. Institut metallokeramiki i spetsial'nykh splavov AN USSR, Kiyev.

(Boron) (Metals)

82988
S/181/60/002/008/007/045
B006/B070

24.7500

AUTHORS: Kislyy, P. S., Samsonov, G. V.

TITLE: The Diffusion of Boron in Carbon

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 8, pp. 1729-1732

TEXT: The authors have already performed preliminary experiments on the diffusion of boron in graphite and investigations of the properties of the boron carbide obtained in this way. It is found that by the diffusion of boron in graphite alloys are obtained which show greater solidity and lower brittleness than boron carbide obtained by compression under heat. These alloys have semiconductor properties, and can be utilized for the preparation of high temperature thermocouples. By the diffusion of boron into the surface of graphite samples, their corrosion resistance becomes noticeably higher, particularly at higher temperatures (Refs. 1-5). The purpose of the present work was to investigate the mechanism of diffusion and to determine its parameters. The object investigated was a cylindrical sample of spectroscopically pure graphite

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The Diffusion of Boron in Carbon

onto whose surface a 2 mm thick layer of a paste of amorphous boron was applied. After the samples had been dried at 150°C, they were enclosed in a graphite shell and preheated in an atmosphere of hydrogen (700 - 800°C, 60 - 80 min). After this treatment the samples were subjected to metallographic, chemical, and X-ray analyses. Further, the reverse process of diffusion of carbon in boron was investigated. For this purpose, boron samples of a porosity of 36% were employed. They were prepared by compression of boron powder and sintering at 1900°C. In this case there resulted a saturation of the carbon samples with carbon in 30 minutes in a vacuum oven at 1940°C. Experiments showed that in similar conditions the boron penetrates deeper in carbon (1.4 - 1.6 mm) than carbon does in boron (0.6 - 0.8 mm). This indicates a remarkably higher mobility of boron atoms. The diffusion coefficients were calculated to be $6.2 \cdot 10^{-6}$ cm²/sec (B→C) and $1.8 \cdot 10^{-6}$ cm²/sec (C→B). Numerical data for two samples showing boron content at different depths of the carbon sample (chemical analysis) are given in Table 1. Their graphical representation is given in Fig. 2. The boron concentration diminishes exponentially with depth. That a solid solution is formed due to

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The Diffusion of Boron in Carbon

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diffusion, is shown by an X-ray analysis. Here the interplanar spacings of graphite lattice are measured as function of boron concentration (Fig. 3). Further, the temperature dependence of diffusion of boron in graphite is investigated (Fig. 4). $D = 3.02 \exp(-28625/T)$ is found to hold. Numerical values are given in Table 2. There are 4 figures, 2 tables, and 6 Soviet references.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Powder Metallurgy and Special Alloys of the AS UkrSSR)

SUBMITTED: October 20, 1959

Card 3/3

84084
S/181/60/002/009/025/036
B004/B056

9,4173

AUTHORS: Neshpor, V. S., Samsonov, G. V.

TITLE: Investigation of the Electrical Conductivity of Silicides of the Transition Metals

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 9, pp. 2202 - 2209

TEXT: A report is given on the potentiometric measurement of the specific electric resistance of silicides of d- and fd-metals of groups IV - VIII of the periodic system as a function of their silicon content. The results obtained are given in a table. The temperature dependence of the electric resistance was measured on the disilicides of Ti, Nb, W, Mo, Re, and La, as well as on silicides of Mo with different Si-content, and on partly Al-substituted Si (Figs. 1,2). Fig. 3 shows the electric resistance of $LaSi_2$ as a function of temperature, and Fig. 4 the electric resistance of disilicides of transition metals of groups IV - VI as a function of the acceptor properties $\xi_{Me} = 1/N_d n_d$, where $N_d$ is the main quantum number of the d-shell of the metal atom, and $n_d$ is

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the number of d-electrons in the free metal. The majority of the silicates investigated were metallic conductors with the exception of the disilicides of Ba, Cr, Fe, Re, and Mn, which are semiconductors. In Me - Si systems, in which the highest silicide ($MeSi_2$) has metal conductivity, the electric resistance of the intermediate silicides decreases with increasing Si content. If, however, the highest silicide is a semiconductor, the reverse behavior is observed. The electric resistance of the disilicides of groups IV - VI is a function of the acceptor property $\xi$ of the d-shell of the metal atom. The highest electric resistance was measured at $VSi_2$ ($\xi_V = 0.111$). With $\xi_{Me} > \xi_V$ the resistance of the disilicides decreases with increasing $\xi_{Me}$ just as in the case of carbides, nitrides, and borides of the transition metals. With $\xi_{Me} < \xi_V$, the behavior is reversed like in the case of pure metals. The resistance of the disilicides of rare earths (fd-transition metals) is considerably higher than that of the disilicides of d-transition metals. L. Yudina, student at L'vovskiy gosudarstvennyy universitet im. I. Franko (L'vov State University imeni I. Franko) took part in the experiments. There are

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Investigation of the Electrical Conductivity of Silicides of the Transition Metals

S/181/60/002/009/025/036
B004/B056

4 figures, 1 table, and 24 references: 17 Soviet, 1 US, 2 British, 1 German, and 1 Australian.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR, Kiyev (Institute of Powder Metallurgy and Special Alloys of the AS UkrSSR, Kiyev)

SUBMITTED: November 9, 1959

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24.7700 1043, 1155, 1158

S/063/60/005/005/004/021
A051/A029

AUTHOR: Samsonov, G.V., Professor

TITLE: New High-Temperature Semiconductors and Their Application

PERIODICAL: Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva im. D.I. Mendeleyeva, 1960, No. 5, Vol. 5, pp. 515-521

TEXT: With the development of high-temperature processes in chemistry, metallurgy, power engineering, etc., the need for semiconductor materials and apparatus reliable for exploitation under conditions of high temperatures and aggressive media or mechanical stress has arisen. Modern techniques also demand the production of high-capacity thermogenerators with a high efficiency factor for the direct transformation of heat liberated in the burning of cheap natural gas, operation of reactors and in burning of ordinary fuels to electric energy. For this purpose semiconductor materials with a melting point of 2,000-2,500°C are required. This is accomplished by using the metals of the transition group of the periodic table of elements to-

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New High-Temperature Semiconductors and Their Application

gether with non-metals: boron, carbon, nitrogen, silicon, or by direct combination of the non-metals. The chemical stability and the electrical and magnetic properties of these compounds are determined by the participation of the electrons of the incompletely built d-shell of the transition metal in the chemical bond in addition to the valency electrons. The unique crystal structure of these compounds brings about the high melting point, hardness and heat-resistance. All these compounds are characterized by heterodesmic properties. The polarizing or accepting tendency of the transition metal atom, indicating the extent of the effect of the unfilled d-electron level on the distribution of the electron concentration in the crystal, is expressed by the relationship 1/Nn, where N is the quantum number of the d level, and n the number of electrons. Table 1 lists the electrophysical properties of silicides of transition metals, where the 1/Nn criterion varies according to the transition metal. An increase in this criterion, generally, would cause a shift of the relative maximum of the electron density toward the shells of the transition metal atoms, and this shift would be

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the much greater, the less the ionization potentials of the valency electrons of the non-metal atoms. In cases where conditions are created for a sharply defined asymmetry of the electron density distribution, energy breaks in the crystals take place, and zones of forbidden states of lesser or greater width occur, and these circumstances can cause semiconductor properties. A change in the electronic density causes an increase of the ion bond fraction expressed through the general shift of the electron collective toward the direction of the non-metal atom shells, and the formation of energy breaks sufficient for the occurrence of semiconductor properties. With a decrease in the ionization potential of the metalloid (when changing to carbon), the valency electrons of the latter lend themselves more readily to bonding and the position of the relative maximum of the electron concentration shifts towards the metal atom, increasing with an increase in the value of 1/Nn. It is pointed out that the addition of metal atoms and non-metals takes place by collectivized electrons, the zones of the s-,d-, and p-electron energy states overlap, and so semiconductor properties cannot be

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New High-Temperature Semiconductors and Their Application

expected in most carbides. Experiments have proven this difficulty (Ref. 8-10). When shifting to the borides, the unity of the electron collective is maintained. The author further describes the borides as being compounds with a primarily metal nature of its bond and a metal type of conductivity (Ref. 8-10). Fig. 1 is a diagram of the structural elements of silicon atoms in silicide lattices. Regarding the latter, semiconducting properties were detected in chromium, iron, nickel, manganese and rhenium silicide (Ref. 6,8, 11,12). The author claims that the semiconductor properties of the silicides have the highest practical significance at the present time. All silicide systems are divided into two groups according to the relationship of the electric resistance and the atomic content of silicon (Fig. 2): 1) silicides forming Ti, Zr, V, Ta, W and Mo compounds, 2) those forming Cr, Fe, Re, Mn compounds (Table 1). It is found that the electric resistance of the silicide phases in the systems Me-Si follows a certain rule: with an increase in the silicon content it increases in the systems, where the higher silicide is a semiconductor, and decreases where the higher silicide has a

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metal conductivity. The reason for this rule is the fact that in systems with metal compounds the atoms of the metalloids, although forming covalent bonds with one another, their bond with the metals has a metallic nature and is achieved by the electron collective. A drop in the electric resistance of the silicides with an increase in temperature is explained mainly by the expansion of the elementary nucleus causing a lesser coverage of the zones (Ref. 7). In order to find and produce semiconductors with predetermined properties, it is important that the nature of the conductivity of the silicides, as well as other compounds of the same type be determined not by the interaction between the metal atoms, suggested in certain articles (Ref. 15), but mostly by the nature of the bond between atoms of the metal and non-metal, which determines the degree of filling of the energy bands in the crystal of the compound. In discussing the second large group of difficultly fusible compounds (non-metal compounds of silicon and boron with carbon and nitrogen, boron and silicon, and their respective alloys) it is noted that this group is represented exclusively by semiconductor phases, which have

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already found practical application. Carbon and boron, and also the compounds of boron and silicon combined with phosphorus, and of aluminum with boron, belong to this group. The main characteristic of these compounds is the formation of covalent bonds between atoms in the composition of their non-metals. This leads to the formation of linear, chain, laminated or skeleton elements of non-metallic atoms from one or several kinds in their crystal structures. The special features of the semiconductor properties of the non-metal compounds are determined by the ability of the non-metal atom to give off the external electrons for bonding, which in the first approximation is evaluated by the magnitude of the ionization potential of the non-metal atom. The same was noted for pure crystals from non-metals (Table 3). From here it is seen that the break between the permitted energy levels increases with an increase in the ionization potential of the non-metal atom, i.e., with an increase of the ion component of the bond. In non-metal difficultly fusible compounds the width of the forbidden zone increases with an increase of the ionization potentials of the components. Silicon carbide,

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SiC, is further discussed as being the most investigated compound of this type, and the formation of the n-conductivity in it is described. Fig. 3 shows a typical curve of the relationship between the electroresistance of the SiC admixture and the temperature (Ref. 16). At the present time it has definitely been established that two chemical compounds exist in the system boron-carbon: $B_{12}C_3(B_4C)$ and $B_{13}C_2(B_{6.5}C)$ and the existence of two other compounds is assumed (Ref. 20) in the area rich in boron, $B_{12}C$, and in the area rich in carbon, $BC_2$. All the alloys of boron and carbon possess semiconductor properties, whereby the greatest thermal emf are noted in defective structures based on compounds of $B_{12}C_3$ and $B_{13}C_2$. The specific electric resistance of the latter is of the order of 1 and 10 ohm·cm; its relationship to temperature was studied only for $B_4C$ up to 2,100°C, and it was established that this carbide has a width of the forbidden zone equalling 1.64 ev and changes to self-conductivity at 1,400-1,450°C. A future commercial use is expected for silicon nitride as a high-temperature material. Boron nitride, known in two modifications: similar to the structure of graphite

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New High-Temperature Semiconductors and Their Application

(Fig. 4) and to cubic diamond-like structure, is also considered as a high-temperature semiconductor. The properties of only the ordinary graphite-like boron nitride have been studied until now. The alloys of boron and silicon (Ref. 24) have also semiconductor properties and have the outstanding feature of possessing a high heat-resistance and chemical stability in acid and alkaline media. The semiconductor properties of boron have been more carefully studied in recent times (Ref. 25). A study of the Hall effect, the thermal emf and rectifying properties of the boron single crystals has shown that at high temperatures the crystals are hole conductors, and at low temperatures the low-ohm crystals have an electronic admixture conductivity. At room temperature boron reveals effects of current rectification and photoconductivity. Scientific interest is expressed in the electrical properties of boron phosphide, BP, belonging to the class of semiconductor compounds of the $A^{III}B^{V}$ type, and also in certain phosphides and sulfides of the d- and f-transition metals. Variation in the electrical stability and chemical properties can be attained by using the alloys of metal-like com-

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pounds not having semiconducting properties, together with semiconductor silicides or with non-metal semiconductors, and also alloys of non-metal difficultly fusible compounds. The alloy of boron carbide with molybdenum silicide is discussed as belonging to the class of Novotny phases with a wide range of homogeneity. These types of semiconductor phases are used for junctions in thermocouples intended for the direct measuring of temperatures of chemically-aggressive substances, molten metals, slag, and gases heated to very high temperatures (Fig.6). In the thermocouples ПТ-1(PT-1), ПТ-2 (PT-2), ПТ-3(PT-3), ПТ-4(PT-4) manufactured today, the external cover is made of molybdenum silicide, zirconium boride, titanium carbide and titanium boride, respectively. The internal rod is made of borinated graphite, which is found to be technically more convenient than using rods made of boron carbide. Thermocouples made of molybdenum and rhenium silicide, of which the first has metallic conductivity and the second is a semiconductor, are considered to have great prospects for the future. Further interest is revealed in silicon and boron nitrides as high-temperature thermistors and as

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part of so-called non-wire or volume resistors (Fig. 8). Wave-guide absorbers are made of silicon carbide. The range of the positive coefficient of the electric-resistance of the silicon carbide admixture (600-1,500°C) is used in the operation of high-temperature carborundum heaters for electric resistance furnaces. High-temperature semiconductors based on silicon carbide are also used extensively as sources of infra-red radiation in spectroscopy and drying. The semiconductor properties of boron carbide are applied in automation, electrical engineering, for producing resistors compensating for the effect of temperature change of the surrounding medium on the showings of magnetic-electrical systems in electric-measuring devices (Ref. 29). Compounds of silicon and boron carbide are considered useful materials for producing high-ohm volume resistors (Ref. 33). By developing a production method of silicon carbide and of boron carbide single crystals of high purity, the latter could be used in industry as first-class rectifiers. There are 3 tables, 3 diagrams, 1 photograph, 4 figures and 33 references: 25 Soviet, 8 English.

Card 10/11

SAMSONOV, G.V. [Samsonov, H.V.]; TSEBULYA, G.G. [TSebulia, H.H.]

Effect of additions of carbon and titanium on the electrical conductivity of silicon nitride. Ukr. fiz. zhur. 5 no. 5:615-619 S-O '60. (MIRA 14:4)

1. Institut metallokeramiki i spetsial'nykh splavov AN USSR.
(Silicon nitride--Electric properties)
(Carbon) (Titanium)

SAMSONOV, G.V.

S/078/60/005/008/012/018
B004/B052

AUTHORS: Vereykina, L. L., Samsonov, G. V.

TITLE: A Simple Method of Producing Titanium Phosphides

PERIODICAL: Zhurnal neorganicheskoy khimii, 1960, Vol. 5, No. 8, pp. 1888-1889

TEXT: The authors give a brief description of western papers on titanium phosphides (Refs. 1 - 6). They investigated the reaction of titanium powder and $PH_3$ in an apparatus depicted in a Fig. $PH_3$ was produced by igniting a stoichiometric mixture of aluminum powder and red phosphorus in a steel cylinder by means of a magnesium band. The aluminum phosphide was decomposed by intensive cooling with a 10% $H_2SO_4$ solution in argon free from oxygen, and the mixture of argon and $PH_3$ was conducted over a quartz boat containing the titanium powder. The analysis of titanium phosphide was conducted according to a method by O. I. Popova and O. G. Seraya. The phosphide was dissolved in a mixture of $HNO_3$ and HF, the titanium was combined by a tartaric acid complex,

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and the phosphorus was precipitated as phosphomolybdic acid. The results are listed in a Table. The development of titanium phosphide only sets in at 700°C. $Ti_2P$ develops at 800°C after 6 h, and TiP at 850°C. The development of $Ti_3P$, assumed by the authors, must yet be proved by further investigations. There are 1 figure, 1 table, and 6 non-Soviet references.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR, Laboratoriya tugoplavkikh materialov (Institute of Cermets and Special Alloys of the Academy of Sciences, UkrSSR, Laboratory for ~~High-melting~~ Refractory Materials)

SUBMITTED: July 9, 1959

SAMSONOV, G.V.

S/078/60/005/008/017/018
B004/B052

AUTHORS: Paderno, Yu. B., Samsonov, G. V.

TITLE: Borides of the Metals of Rare Earths

PERIODICAL: Zhurnal neorganicheskoy khimii, 1960, Vol. 5, No. 8, pp. 1914-1915

TEXT: The authors criticize a paper by N. N. Tvorogov on "Investigation of Hexaborides of Rare Earths and Yttrium" published in the "Zhurnal neorganicheskoy khimii", 1959, Vol. 4, pp. 1961-1966: (1) Tvorogov states that he used boron carbide containing 72.61% of B, while his reaction equations are only applicable for $B_4C$ with 78.3% of B; (2) the experimental temperatures described, are unintelligible from the view-point of the formation kinetics of borides; (3) the data of the chemical analyses confirm the development of hexaborides, while the radiographic analysis proves the existence of several phases. Therefore, the chemical analyses are dubious; (4) the lattice constants of hexaborides and the pycnometrically determined densities are also doubted.

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Borides of the Metals of Rare Earths

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(5) The published data are incomplete. Finally, the authors report that they produced thulium tetraboride by reducing thulium oxide by means of boron at 1600 - 2100°C. The respective lattice constants are given. There are 13 references: 10 Soviet, 1 US, and 2 Czechoslovakian.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR (Institute of Cermets and Special Alloys of the Academy of Sciences UkrSSR)

SUBMITTED: November 13, 1959

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83127

S/078/60/005/009/010/017
B015/B064

15.2220
24.7700

AUTHORS: Portnoy, K. I., Samsonov, G. V., Solonnikova, L. A.

TITLE: Melts in the System Boron - Silicon - Carbon

PERIODICAL: Zhurnal neorganicheskoy khimii, 1960, Vol. 5, No. 9, pp. 2032-2041

TEXT: The conditions of synthesis and properties of some B-Si-C melts were determined by microscopic-, X-ray-, microanalytical-, and chemical analyses, and the melting temperature and electrical properties of the melts $B_4C$-Si and SiC-B were determined. On investigating $B_4C$-Si melts, chemical analyses (Table 1) showed that a silicon content is found in the mixture which is close to the theoretical value of 25-35 wt% Si. When determining the specific weight (Table 2) a maximum value was found to be attained at approximately 30% Si, which may be traced back to the formation of a new phase with denser packing. At an Si content of 10-50% the melting point varies between 2200° and 2400°C, to decrease at 70% Si to 1600°-1700°C. At an Si content of approximately 25 wt% in the alloy, a hardness maximum of about 7000 kg/mm² was found to exist, where also a maximum of electrical resistance, and a minimum of thermo-electromotive force was determined, and the



APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001447020001-2"

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Melts in the System Boron - Silicon - Carbon S/078/60/005/009/010/017
B015/B064

alloys exhibit semiconductor properties. $B_4C$-Si alloys with 25 - 50% Si (Table 3) proved to be most heat resistant. A ternary compound $B_5SiC_2$ was assumed to be present. Similar results were also obtained with SiC-B alloys (Tables 4-6), and the formation of the ternary compound $B_3Si_2C_2$ was assumed. Both alloys were found to possess semiconductor properties, with the thermo-electromotive force of the mentioned new compounds reaching values of 150-200 µb/degree. A. A. Kalinina, F. I. Shamray, and B. F. Ormont et al. are mentioned in the paper. There are 13 figures, 6 tables, and 25 references: 17 Soviet, 1 German, 6 US, and 1 British.

ASSOCIATION: Vsesoyuznyy institut aviatsionnykh materialov (All-Union Institute for Aviation Materials). Institut metallokeramiki i spetsial'nykh splavov Akademii nauk USSR (Institute of Powder Metallurgy and Special Alloys of the Academy of Sciences of the UkrSSR)

SUBMITTED: June 4, 1959

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S/051/60/008/03/026/038
E201/E191

AUTHORS: Serebryakova, T.I., Paderno, Yu.B., and Samsonov, G.V.

TITLE: The Emissivities of Powders of Some Refractory Compounds

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 3, pp 410-412 (USSR)

ABSTRACT: The authors report measurements of the emissivities of powders of borides, carbides and nitrides of refractory and rare-earth metals. Measurements were carried out with an instrument shown in a figure on p 410. This instrument simulated closely an absolute black body. A tantalum cylinder 5 (20 mm diameter, 50 mm height) served as a heater. Inside the cylinder 5 there was another smaller tantalum cylinder 6 (8 mm diameter, 20 mm height) which was placed concentrically with the cylinder 5. In each of the cylinders there was a small aperture and these apertures were aligned horizontally. The lower ends of the two tantalum cylinders were fixed to a molybdenum plate 4 which was pressed against the cylinder 5 by a spring. The whole instrument was enclosed in a glass bulb 1. The inner cylinder 6 was coated with 100 μ thick layer of paste prepared from a fine powder (particles of

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The Emissivities of Powders of Some Refractory Compounds

2-3 μ diameter) of the refractory material mixed with a binder. Temperature of the inner cylinder surface (the brightness temperature, $T_b$) and temperature in the aligned apertures (the true temperature $T_t$) were measured with an pyrometer OPPIR-09. Absorption in the glass bulb was found to be negligible. The emission intensities were measured at 650 mμ and the emissivities were calculated using the following formula:

$$\ln \varepsilon_\lambda = \frac{c}{\lambda}\left(\frac{1}{T_t} - \frac{1}{T_b}\right)$$

where c = 1.438 cm/deg and λ is the wavelength. The measured emissivities of pure tantalum at temperatures from 800 to 2000 °C agreed well with the published values (Table 1). The measured emissivities of $LaB_6$, $NdB_6$, $SmB_6$, $GdB_6$, $YB_6$, $ZrB_2$, $HfB_2$, $B_4C$, TiC, $Cr_7C_3$ and BN powders at temperatures from 850 to 1650 °C are listed in Table 2. There are 1 figure, 2 tables and 6 references, of which 3 are Soviet, 2 English and 1 German.

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SUBMITTED: August 8, 1959

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S/126/60/010/004/022/023
E073/E435

24.7700 1043, 1143, 1559 only
5.2610 1273, 1160 only

AUTHORS: Paderno, Yu.B., Samsonov, G.V. and Fomenko, V.S.

TITLE: Electrical Properties of Lanthanum Boride

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.4, pp.633-635

TEXT: To determine the dependence of the electric resistance on the porosity for hexaborides of rare earth metals, the authors produced specimens of lanthanum boride with a porosity between 2 and 37%, increasing by steps of 1 to 2%. The specimens were of 6 mm diameter, 10 mm length. The measurements were carried out by the compensation method by means of a potentiometer. The obtained results (resistance, $\rho \times 10^{-6}$ versus porosity, percent) are plotted in Fig.1. In the same figure, the following relations are also plotted which are applied by various authors (Refs.1 to 5) in calculating values of the electric resistance of porous specimens:

$$\rho_o = \rho(1 - P)^{3.5} \quad (1)$$

$$\rho_o = \rho(1 - P)^3 \quad (2)$$

$$\rho_o = \rho \frac{2 - 3P}{3} \quad (3)$$

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E073/E435

Electrical Properties of Lanthanum Boride

$$\rho_o = \rho(1 - P) \quad (4)$$

$$\rho_o = \rho \exp\left(-\frac{A}{1 - P}\right) \quad (5)$$

These dependences were obtained for the conductivity of a mixture of phases. In the case under consideration, the specimen can be considered as consisting of two phases, the compact material and cavities. It was found that the experimental results agree best with those obtained by Eq.(2) of Landau and Lifshits (Ref.2) although this equation was derived on the assumption that the difference between the conductivities of the phases was low. As was to be anticipated, the emf proved practically independent of the porosity (Fig.2). On a specimen with a 2% porosity the temperature dependence of the electric resistance of lanthanum hexaboride was measured up to 2000°C (Fig.3). It was found that lanthanum boride is a typical metallic conductor with a thermal resistance coefficient of 0.060 microohm cm/°C. This value is considerably lower than the thermal resistance coefficient of

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Electrical Properties of Lanthanum Boride

metallic lanthanum. This is attributed to the considerably larger rigidity of the crystal lattice of hexaboride compared to that of the metal (the characteristic temperature of lanthanum boride is 885°K whilst that of lanthanum is 152°K) and also to a change in the energy states of the electrons of the metal when forming compounds. There are 3 figures and 6 references: 4 Soviet and 2 English.

ASSOCIATION: Institut metallokeramiki i spetsial'nykh splavov AN USSR (Institute of Cermets and Special Alloys AS UkrSSR)

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Card 3/3

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S/073/60/026/004/002/008
B016/B054

AUTHORS: Paderno, Yu. B., Fomenko, V. S., and Samsonov, G. V.

TITLE: Production and Some Properties of Neodymium Hexaboride

PERIODICAL: Ukrainskiy khimicheskiy zhurnal, 1960, Vol. 26, No. 4, pp. 409-411

TEXT: The authors studied two methods of producing neodymium hexaboride: 1) the reduction of neodymium oxide by the carbon of boron carbide with simultaneous reaction of the metal with boron, and 2) direct reduction of the metal oxide by boron (see reaction schemes). In both cases, the process was carried out in a vacuum furnace with a graphite heating element (1100 - 1800°C). The gaseous reaction products were continuously pumped off. The completeness of the reaction process was controlled by means of X-ray and chemical analyses of the product. The authors conclude from the results that in both cases the best results of hexaboride production are attained by heating the components to 1600-1650°C for 1 h. A finely disperse, dark-blue powder was formed, whose B-content was near the stoichiometric composition. The parameter a = 4.124 A was calculated

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Production and Some Properties of Neodymium Hexaboride

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by the data of the radiograph (Table 1), which agrees with the data found in publications (Ref. 2). Compact samples were prepared from powdery neodymium hexaboride by pressing at 2000°C for 15-20 min at a pressure of 175-200 kg/cm$^2$ (optimum conditions). Minimum porosity of these samples was 3%. The value measured by the authors for the electrical resistivity (20 μohm · cm) lay considerably below that of the metal (64.3 μohm · cm). The coefficient of the electromotive force, measured as a $BN_6$-Pt thermocouple between room temperature and 700°C, rises continuously with the temperature, as corresponds to metallic conductivity. Finally, the authors measured the radiation coefficient at 1600°C, the microhardness, the melting temperature, and the electron work function. A comparison of the properties of neodymium hexaboride with those of the borides of other rare earths showed that the electrical resistivity and the work function increase in the order from lanthanum to neodymium. This agrees with Hund's rule. There are 1 table and 12 references: 8 Soviet, 2 French, and 2 German.

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