temperature evolution in a mixture of molybdenum-bor BY USE OF MICROWAVE DISCHARGE

G.M. Batanov, L.V. Kolik, E.M. Konchekov, A.A. Letunov, D.V. Malakhov, A.E. Petrov, I.G. Ryabikina\*, K.A. Sarksyan, N.N. Skvortsova, A.S. Sokolov\*, V.D. Stepakhin, N.K. Kharchev

GPI RAS, Moscow, Russia, [sarksian@fpl.gpi.ru](mailto:sarksian@fpl.gpi.ru)  
\*MSTU MIREA,Moscow, Russian Federation, mukudori@mail

During the last decade have been extensively studied properties of the microwave discharge, which occurs in the powder metal-insulator transition in the field of high power microwave (gyrotron discharge [1]. Discharge occurs during the fall of the microwave beam on a mixture of a metal and an insulator disposed between radioparent quartz plates into the air. In this case, the volume of the mixture occurred with a high density plasma of charged particles (~ 1017 cm-3), which is effectively absorbed microwave radiation.In [2 ] describes the evolution of the temperature in the discharge, which was initiated by microwave radiation in a mixture of Ti-B in the air. Experiments to study the properties of a microwave discharge in Ti-B powders were continued with the implementation of the microwave discharge in a specially constructed plasma-chemical reactor with an open boundary gyrotron powder using a frequency of 75 GHz , the pulse duration to 10 ms , capacity - up to 550 kW . [3] As a result, particles were synthesized by micro and nano sized titanium diboride and boron nitride . [4]

The report describes the results of temperature changes over time of the microwave discharge in Mo-B powder and Mo-BN in a reactor with the exposed surface in an atmosphere of nitrogen and air. Unused amorphous boron powder with a particle size of ~ 1 ... 5 mm , and molybdenum powder with particle size of about 30 ... 40 mm. The discharge was generated pulse gyrotron with a frequency of 75 GHz, 4 ms duration and up to 350 kW. For optical measurements, the temperature used as illumination lines of atoms and ions of the basic substances and glow lines impurities ( iron, titanium and oxygen, etc. ) which are present in small amounts. In experiments were registered two phases of development of the microwave discharge. In the first phase after the breakdown of the spark plasma discharge develops , in which the optical spectra against a continuous line as a continuum defined atoms (MoI, NI, TiI, FeI, etc.), and ions (MoII, NII, TiII, etc. ) . The K.°surface temperature of the powder , plasma and gas reached ~ 4000 ... 6000 In the second phase was initiated by the development of chemical reaction exothermic self-propagating high-temperature synthesis . Synthesis reaction evolved as a basic substance and the impurities. In the optical spectrum against a continuous broad continuum observed molecular bands , atomic lines have not been determined . Duration of high-temperature synthesis reached 40 ... 50 ms , during which there was a slow decrease in temperature from about 4000 K to about 1000 K. Such microwave discharges can be used in nanotechnology for the synthesis of new materials

Literature

1. Batanov G.M., Berezhetskaya N.K., Kossyy I.A., Magunov A.N., Silakov V.P.,*ZhTF* [Technical Physics]. 2001. Vol. 71. Iss. 7. P. 119…123.
2. BatanovG.M., Berezhetskaya N.K., Kop'ev V.A., Kossyy I.A., Magunov A.N. Evolyutsiya, *Khimicheskaya Fizika* [Chemical Physics]. 2013.Vol. 32. № 4.P. 52…59.
3. Batanov G. M., Berezhetskaya N. K., Borzosekov V. D., PLASMA PHYSICS REPORTS, 2013,Vol. 39 No. 10, P 843-848
4. Batanov G. M., Berezhetskaya N. K., Borzosekov V. D.,Journal of

Nanoelectronics and Optoelectronics,2013,Vol. 8,P. 58–66