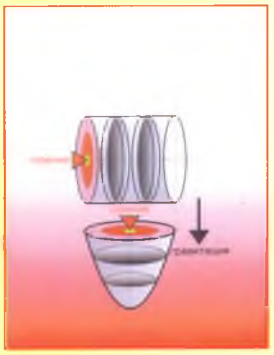
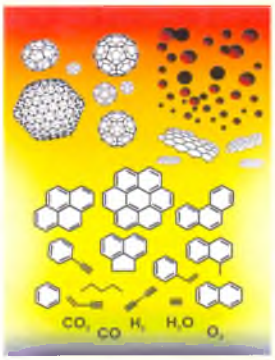
Ministry of Education & Science of the Republic of Kazakhstan / Қазақстан Республикасы Білім және Ғылым Министрлігі
Министерство Образования и Науки Республики Казахстан

al-Farabi Kazakh National University / әл-Фараби атындағы Қазақ ұлттық университеті
Казахский национальный университет им. аль-Фараби

Proceedings of the Joint International VIII Symposium "Combustion & Plasmochemistry"

The Institute of Combustion Problem. Институт проблем горения. МОН РК - Комитет Науки





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Бірлескен VIII "ЖАНУ ЖӘНЕ ПЛАЗМОХИМИЯ" халықаралық симпозиумы мен "ЭНЕРГИЯЛЫҚ ТИІМДІЛІК-2015" ғылыми техникалық конференциясы

Совместный VIII международный симпозиум "ГОРЕНИЕ И ПЛАЗМОХИМИЯ" и научно-техническая конференция "ЭНЕРГОЭФФЕКТИВНОСТЬ-2015"

September, 16-18, 2015, Almaty, Republic of Kazakhstan

EFFECT OF EXTERNAL FACTORS ON THE OBTAINING OF MgB_2 PREPARED BY SHS

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Abstract
In this paper, we presented the results of studies on the synthesis of MgB_2 with external affecting factors such as a gas pressure and centrifugal acceleration which synthesized by SHS technique.

Introduction

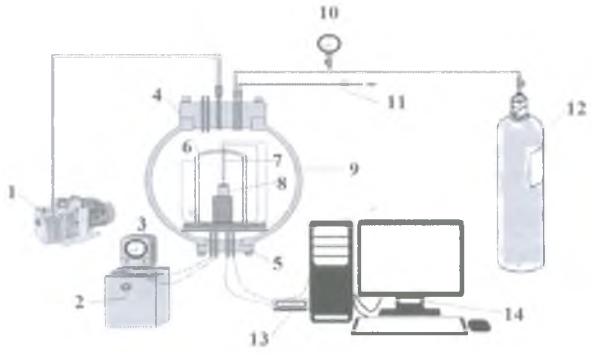
Self-propagating high-temperature synthesis (SHS) - an effective way to the fabrication of many materials with high levels of quality [1]. The advantages of using SHS are: low power consumption, high speed synthesis, high efficiency, no pollution of the environment. This method is widely used for obtaining various superconductor materials. Magnesium diboride (MgB_2) is considered as a new superconductor [2] having great potential for application and a lot of research activity has risen recently on this compound. High-pressure and centrifugal acceleration are promising factors for manufacturing of the MgB_2 superconductive material with new properties. The discovery of superconductivity at 39 K in MgB_2, which has a simple binary chemical composition and can be fabricated in a variety of material forms, attracted much interest for a range of practical applications. MgB_2 exhibits many impressive superconducting properties such as highest critical temperature among intermetallic superconductors, which translates directly to low cooling costs, strongly coupled grain boundaries for the flow of current, the ability to carry greater critical current density, [3–5] a comparatively large coherence length, which potentially enables the fabrication of Josephson junctions, a relatively simple crystal structure and relatively low material costs.

Experimental part

In order to investigate influencing of external factors, the authors were performed following experiments:
The MgB_2 samples were obtained by self-propagating high-temperature synthesis (SHS) in two setups as high pressure reactor and high temperature centrifuge where we were investigated the influencing of gas pressure and centrifugal force on yield of MgB_2 phase.

To determine of influencing of gas pressure of Ar on the yield of MgB_2 had been performed following experiment: To synthesis of magnesium diborides we used Mg (98%) and amorphous B powder (94%). The mixtures of Mg and B powders were prepared in the following proportions 55.3% Mg and 44.7% B. The two powders were carefully mixed in the high energy ball milling for 3 min and then a mixture was pressed into the specimens less than 40 tons at 30 mm in diameter and 12 mm thick. Then the pressed of initial powders of Mg and B was placed into cylindrical preheating furnace of the high pressure reactor (Fig.1.) and then was heated to initiate SHS process. The pressure of Ar up to 25 atm. was created in it. Self-sustaining synthesis was initiated at about 650°C (magnesium m.p.). The temperature of the powder bed increased to about 1100°C-1200°C.

The reaction was completed after 2-5s. The temperature controller maintained the temperature inside the reactor, while the combustion temperatures inside the samples were recorded by using micro thermocouples. XRD are shown that samples have 2 main phases: MgB_2 (85 wt. %) and MgO (12.6 wt. %). XRD were revealed the presence of well-crystallized MgB_2 phase in bulk samples. Some small impurities of MgO and Mg were also identified. SEM analyze is showed that MgB_2 samples had the average grain size in the range from about 10 to 45 μm. The superconducting parameter was measured by PPMS setup (UTB, the USA). According to this measure, the critical temperature of obtained sample was 38.5 K (Fig.2.).



1 - the vacuum pump 2 - transformer, 3 - ampermeter 4 - upper cover of the reactor, 5 - the bottom of the reactor lid 6 - tubular heating furnace 7 - thermocouple 8 - sample 9 - reactor vessel 10 – manometer 11 - intake and exhaust valves 12 - nitrogen cylinder 13 - collection system data LTR-U-1 14 – a computer

Fig. 1– A scheme of high pressure reactor

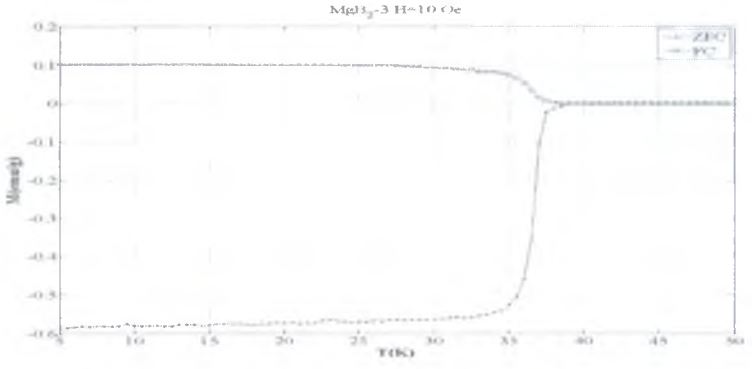


Fig. 2 – Temperature dependence of magnetization at applied magnetic field (10 Oe)

To investigate of effects of centrifugal acceleration on the yield of MgB_2 had been performed following experiment: The tablets were pressed from powders of boron and magnesium and charged with the attacking layer (82%CuO + 18%Al) + 50% Al_2O_3)) in a quartz tube (Fig.3).

This mixture was ignited by means of powder which has been initiated itself electrocution. In the high-speed rotation of the centrifuge set within 2000 rpm. SH-synthesis was carried out in a mode of self-ignition in the temperature range from 700^0C to 900^0C. X-ray diffraction analysis of the synthesized MgB2 tablets showed that the yield of MgB_2 was contained within 70%, and the main impurity phase is an oxide MgO in final product. In addition, there were traces of inclusion MgB_4, SiO_2 and $CuMg_2$. The superconducting parameter was measured by PPMS (UTB, the USA). According to this measure, the critical temperature of obtained sample was 37.5 K (Fig.4.).

Fig. 3 – The load scheme of initial mixture in reactor of the high temperature centrifuge and main body of centrifuge

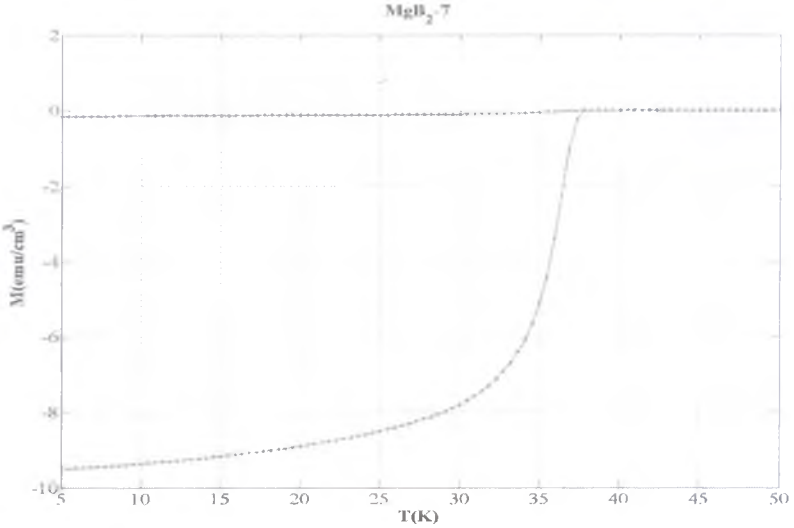


Fig. 4 – Temperature dependence of magnetization at applied magnetic field (10 Oe)

Conclusion

Thus, according to these results, we can confirm that self-propagating high temperature synthesis of MgB_2 can be synthesized in the high centrifuge setup and high pressure reactor. In connection with this, further studies on the influence of centrifugal acceleration and other factors for increasing the yield of magnesium diboride in the final product and improving their superconducting parameters are promising.

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