BN- THERMAL PAD FILLERS PREPARED BY SHS FROM FERROBORON

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In modern electronics, the problem of dissipating the heat generated during operation is a topical one. This is due to a significant reduction in the size and power of the electronic devices [1]. Traditionally, heat sinks have been used to dissipate heat. Thermal interfaces, particularly thermal pads, have successfully improved contact and overcome this problem. BN is widely used as thermally conductive filler [2, 3]. One of the ways to produce Boron Nitride is an energy-efficient method of self-propagating high-temperature synthesis (SHS) or combustion synthesis. Ferroboron can be used as a starting material for the production of Boron Nitride by the SHS method [4]. This work aims to produce boron nitride from ferroboron by SHS nitriding for thermal pads.

Industrial ferroboron (FB17) was used as the starting material for nitriding. Ferroboron contains 16.34 wt% of boron in its composition. A silicone compound (polydimethylsiloxane (PDMS)) with a tin catalyst was used as a polymer binder to produce thermal pads. A constant pressure calorimeter with a volume of 3 liters was used for SHS nitriding. The nitride sample was subjected to acid washing to remove iron. The boron nitride obtained was mixed with PDMS, and 2 mm thick thermal pads were formed.

Due to the low content of boron, which reacts exothermically with nitrogen, the combustion reaction of ferroboron in the self-propagation mode could be initiated under the condition of pre-mechanical activation of ferroboron in a planetary mill (1 min.). The combustion of ferroboron proceeded in a stationary mode, and the samples had a macro-homogeneous structure. The nitrogen content in the obtained samples was 16.9 wt%. The nitrided material consists of two phases, Fe and BN (Fig. 1 a). The nitrided ferroboron was acid-treated with HCl (40%) at 60 ^{o}C. Washing of the nitrided ferroboron for 30 min resulted in single-phase boron nitride (Fig. 1 b).

The boron nitride obtained by the SHS method was mixed with PDMS at up to 40 wt%. Adding more than 40 wt% of boron nitride did not allow the formation of elastic thermal pads. Increasing the content of Boron Nitride in the thermal pad up to 40 wt% resulted in an increase in thermal conductivity up to 1.95 W/mK (Fig. 2). This is due to the high thermal conductivity of Boron Nitride compared to PDMS.

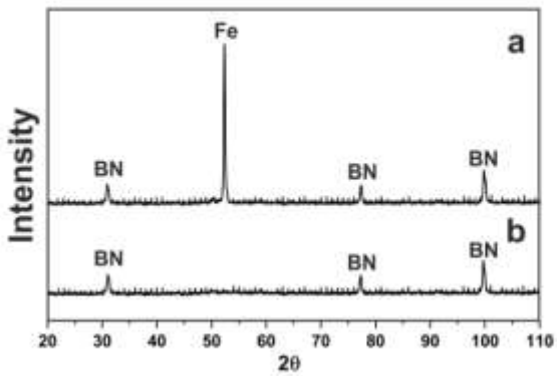

Fig. 1. X-ray diffraction: a – nitrided ferroboron, b – nitride ferroboron after acid enrichment.

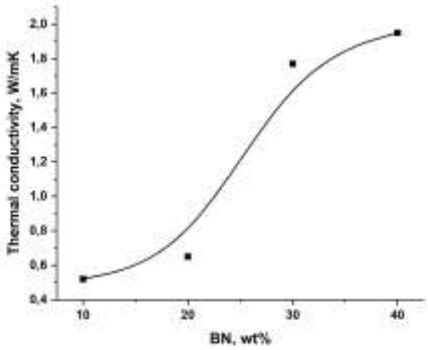

Fig. 2. Thermal conductivity as a function of BN content in thermal pad.

Thus, a monophase boron nitride was obtained by nitriding ferroboron with SHS, which proved effective as a thermally conductive filler for thermal pads.

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