CONTROLLING SOME PARAMETERS INFLUENCE SYNTHESIS OF BORON NITRIDE VIA CARBOITHERMIC REDUCTION REACTION

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Carbothermic reduction reaction route applied during synthesize of boron nitride ceramics. A mixture of boric acid and lactose with different B/C molar ratio firstly prepared. The mixtures loaded in stainless steel pot and treated at 280°C for 20h. The produced cakes divided into two groups for further processing. One group heat treated at 700°C for 2h before transferred into tube furnace at 1500°C for 3h to perform the carbothermic reduction reaction. The second one directly transferred into tube furnace and treated at the same temperature regime. The effect of both heat treatment process prior to carbothermic reaction and the initial B/C ratio on the properties of the final product extensively studied. The XRD and FT-IR analysis proved that for the first group of samples (heat treated prior to carbothermic reaction), the reaction between the starting mixture components is uncompleted via the appearance of considerable amount of boron oxide. While, second group of samples found to not contain any traces of boron oxide which an evidence for the reaction completion between the starting mixture components. In the second group of samples, a composite of boron carbide and boron nitride found to produce with sample containing higher carbon ratio. While, pure hexagonal boron nitride obtained for sample with lower carbon ratio. By applying Scherer equation, the crystallite size of both boron carbide and boron nitride found to be ~ 30 and ~15 nm, respectively. The FE-SEM and TEM investigation proved that the B/C ratio play a vital role in controlling the shape of formed phases. Moreover, the thermal analysis confirms that samples with higher carbon content start to decompose (weight gained) at temperature of ~ 800°C which related to the presence of considerable amount of boron carbide. In contrary, sample with lowest carbon content found to withstand temperature without decomposition till 1000°C confirming the presence of pure boron nitride phase. This investigation not only helps in controlling the synthesis of either pure boron nitride or a composite of boron nitride and boron carbide but also indicate the un-necessity of the heat treatment step prior to carbothermic reaction for synthesis of pure ceramic phase.

Keywords: Boron nitride, Boron carbide, Carbothermic reaction

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