

Combustion Synthesis of AlN Powder and its Sintering Properties

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A combustion synthesis method was developed for synthesis of AlN powder. Al powder and small amounts of NH₄Cl were thoroughly mixed and placed in low-melting-point aluminum containers. A layer of AlN powders were placed in between the reactant powder and the container walls. The combustion reaction was ignited by heating the top surface of the powder stack and the aluminum container was converted completely to AlN during the combustion reaction. High product yields (~99.2%) were obtained under N₂ pressures of around 0.5Mpa. The product was composed of a dense top portion and a loose inner portion and an interface portion close to the AlN packing powder layer. The AlN product obtained from this synthesis method was ground to have average particle sizes of 2 μm for sintering experiments. Yttrium oxide was added to the AlN powder as a sintering aid. The microwave sintering experiments were carried out at the Microwave Processing and Engineering Center in the Pennsylvania State University. The samples were sintered by microwave at 2.45 GHz in a multi-mode cavity. The power used ranged from 200 W to 1 KW, and the sintering temperature ranged from 1750°C to 1850°C. The AlN powder was sintered to ~99% of the theoretical density at a sintering temperature of 1850°C with a soaking time of 30 min and a Y₂O₃ content of 3-10 wt%. The thermal conductivities reached 130 W/m·k for the specimens made from the present AlN powders when 5 wt% of Y₂O₃ was added.