Production of thick-film thermoelectric devices using centrifugal force

One step forward to realization of high-efficiency thermoelectric devices

We have developed a new process, "centrifugally pressurized solidification", utilizing uniform pressure by centrifugal force, and produced thermoelectric thick films. This process enables the production of thick films with microstructure close to single crystal, leading to thermoelectric performance of a practical level. A thermoelectric generation device comprising thick films is characterized by its ability to function as a cooling fin and keep a sufficient temperature difference for thermoelectric generation even by natural cooling, and the ability to be applied to curved structure such as exhaust pipes. The newly developed centrifugally pressurized solidification not only produces thermoelectric thick films close to a single crystal but also simplifies the manufacturing process and increases the yield as compared to the conventional method.

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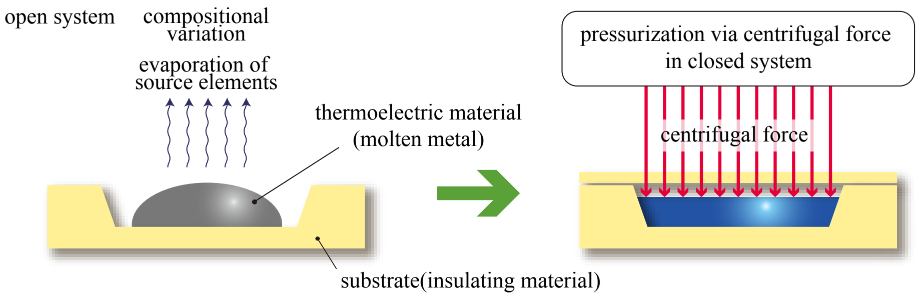

Solidification of thermoelectric materials under centrifugal force in closed system offers thick films with a high power factor.

Nanotechnology, Materials & Manufacturing

A novel and practical method for pressureless sintering of boron carbide

New process greatly lowers the cost of manufacturing the hardest and lightest engineering ceramics

Boron carbide (B_4C) has the highest hardness (HV = 38 GPa) and lowest density (2.52 g/cm^3) among all practical engineering ceramics. However, its sinterability is poor due to the strong covalency of B-C bonding. Densification of B_4C to high densities is usually achieved by hot pressing, which makes the manufacturing cost high and precludes the formation of complex shapes. In this study, we have developed a new method of pressureless sintering of B_4C. When placed in an Ar gas atmosphere containing gaseous Al compounds, B_4C green bodies can be sintered to over 95 % of theoretical density under 2200 °C . When B_4C green bodies are doped with less than 1 % of sintering additives such as Si and W, even higher sintered densities can be achieved. Because they have high sintered densities and contain minimum amount of deleterious secondary phases, the B_4C ceramics prepared by this method have high hardness and mechanical strength. This simple and efficient pressureless sintering method will greatly lower the manufacturing cost of B_4C ceramics and promote their industrial applications in the fields, for example as sandblast nozzles, mechanical seals, hard disk substrates, and other components requiring wear-resistance and light weight.

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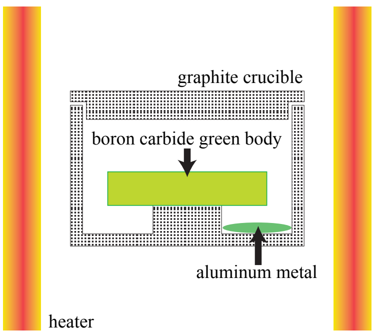

Schematic drawing of the developed sintering technique