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Design of a high-temperature microwave furnace for preparation of highly efficient thermoelectric materials

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The thermoelectric material is a device that can generate electric energy from solar and waste thermal energies. On the other hand, It can generate temperature gradient from electric energy for cooling applications. Recently, researchers are interested in the synthesis of thermoelectric material by using microwave furnace. The efficiency of thermoelectric materials can be increased by microwave assisted synthesis because of rapid sintering and small gain size. High-temperature microwave furnace technology is complicated in the design and control system. The commercial furnaces are very expensive. In this research, we have developed high-power microwave furnace for synthesis of thermoelectric materials. The design of microwave furnace is optimized by Comsol multiphysics. Study of electric distribution in the waveguide and cavity, therefore furnace cavity is optimized to be 28x28x28 cm3. The waveguides and magnetrons are mounted on the four sides of the cavity. Each two waveguides on the opposite sides are placed at 90 degree to each other. The Heating of SIC crucible in the furnace have shown that crucible's temperature can be increased from room temperature to 900o C within only about ten minutes. Heat energy in the furnace depends on the number of operating magnetrons, which is consistent with the distribution of the calculated electric field.

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