Chapter 1

Introduction

Peltier element [1] is a device, which is intended to transfer heat energy by absorption and dissipation. Peltier element is operated efficiently when it is possible to ensure efficient heat absorption at one side of the device, transfer the absorbed heat across the device, and dissipate the heat from the other side.

Peltier element consists of an assembly of small semiconductor pieces mounted between two ceramic plates. This assembly is then clamped to a pair of metallic heat sink, one for absorption of heat so called as "a metallic heat absorption sink" and the other for heat dissipation so called as "a metallic heat dissipation sink". The pair of metallic heat sink is electrically insulated by the alumina substrate.

In the present, the demand of Peltier element for electronic industry has increased and it leads to the increased demand of alumina substrate. The properties of alumina substrate should be high electrical resistance, high thermal conductivity, superior mechanical, strength and cheap cost. The thickness of alumina substrate is very important factor and it is in the range of 0.1 to 0.5 mm. The processes that have been widely used for forming of flat ceramic are extrusion and doctor blade. Extrusion process is generally used for forming flat ceramic, tape thicker than 0.3 mm. On the other hand, doctor blade technique is usually used for a tape thinner than 0.3 mm.

This research was conducted as the contract research with AISIN which is a big Japanese company, produces "Peltier element". Last year, Miss Bongkoch already did the experiment using AES-11 and AKP-30 as raw alumina powder and she got the basic data. But she did not study about the fabrication of thin tape.

The objective of this research is to improve the efficiency of "Peltier element" through improving the thermal conductivity and mechanical strength of alumina substrate by selecting appropriate raw material and improving fabrication technique. In this research, extrusion was used for fabrication of thin tape. Alumina, which is currently used for AISIN "Peltier element" has thermal conductivity of about 24 W/m·K. The thermal conductivity of single crystal Al_2O_3 is about 40 W/m·K. So there is possibility to improve thermal conductivity of Al_2O_3 substrate over 30 W/m·K. for Peltier element.