The effects of PSS and Au addition on thermoelectric properties in β-SiC/Si composites

Hiroshi Nakatsugawa, Kensaku Nagasawa, Yoichi Okamoto, Satarou Yamaguchi, Shinji Fukuda, Hiroyuki Kitagawa

Silicon semiconductor devices such as Power MOSFET, IGBT and CPU are the most important devices to give us modern life. In this system, the heat flux flow directions of the thermal conduction and the Joule heating are the same for the usual Peltier elements. On the contrary, the direction of the Peltier heat flow is the opposite for the usual Peltier element because of the cooling the high temperature objects. When we use these devices in the electric circuit, the heat removal and the cooling down are one of the most important issues because the silicon device must be the temperature of 423K or lower to keep its function.

Recently Yamagushi *et al.*[1] propose the self-cooling device, which does not need to use the additional power circuits because the Peltier cooling is done by its selfcurrent. This technology carries out the Peltier cooling with the use of flowing current in silicon power device itself by using of thermoelectric material instead of cupper electrode in silicon power devices. In particular, silicon carbide (SiC) is one of the candidate material since SiC has the higher electrical conductivity, thermal conductivity and Seebeck coefficient different from conventional thermoelectric material.

In this paper, we investigated the PSS and Au addition effects on thermoelectric properties in β-SiC/Si composites. It is considered that the high sample density and Au additive result in an increase of mobility, and hence lead to enhancement of electrical conductivity. Furthermore, SEM observation to investigate the trend of the high sample density exhibits that there is a peak of the grain growth at PSS 10wt.% additive sample. In order to elucidate the crystal characteristics of β-SiC/Si composites, high temperature XRD measurements are carried out in the temperature range from 300 to 1173K.

[1] S.Yamaguchi, Y.Okamoto, A.Yamamoto and M.Hamabe, *Proc. 26th Int. Conf. Thermoelectrics*, O-G-1, (2007).