Distictive thermoelectric properties of P doped SiGe

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Abstract:

In the earlier work on Silicon Germanium, we have obtained a very low thermal conductivity of 1 W/mK in amorphous SiGe alloy prepared by high energy ball milling. However, the figure of merit ZT was very low due to the high electrical resistivity. In this work, we tried to solve the problem of high electrical resistivity by tuning the carrier concentration. The samples were prepared by high energy ball milling in a controlled atmosphere of Argon and Hydrogen to avoid the oxidation. The bulk samples were prepared by spark plasma sintering at two different temperatures to study the effect of crystallinity on transport properties. The X-Ray diffraction and Scanning electron microscopy confirmed the formation of the semi-crystalline microstructure. In the transport properties, we observed a very large magnitude Seebeck coefficient of ~ 400 μV/ K, electrical resistivity was in few m-ohm-cm range at high temperature, together with a very low thermal conductivity of less than 2 W/mK. The unusual temperature dependence of electrical resistivity was might be due to Anderson localization. Hence, we obtained a very large magnitude of ZT = 1.7 at 1000 K in heavily P doped Semi crystalline SiGe samples. The detailed analysis of microstructure and transport properties will be shown in the presentation.