

**MATERIALS SCIENCE AND ENGINEERING
SEMINAR**

“Using the Traveling Heater Method to Process a Type I and VIII Clathrate Intermetallic Compound for Higher Efficiency Thermoelectric Materials”

By

Kyungjean Min

Purdue MSE Preliminary Exam

Advisors:

Professor David R. Johnson and Kevin P. Trumble

ABSTRACT

For semiconducting applications, intermetallic clathrates have been developed during last the few decades. Intermetallic clathrates are divided into several different types based on their crystalline structure and chemical composition. Among intermetallic clathrates, the type I and VIII clathrate intermetallic compound, $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$, has been in the limelight as an effective thermoelectric material with higher figure of merit that is proportional to the ratio of electric conductivity and thermal conductivity. Type VIII $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$ is the dimorphic structure of Type I $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$ and both can be obtained in different growth conditions. Moreover, the large size single crystal of $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$ is preferred to characterize thermoelectric properties. To grow type VIII clathrate intermetallics the flux growth and Bridgman methods have been utilized until now. However, there are disadvantages in that flux growth method is able to grow small single crystal in size or polycrystal and Bridgman method has a difficulty to grow incongruent melting compound. The crystal grown by both methods has a necessarily deviated stoichiometric ratio because of stoichiometric range in congruent melting line. Traveling heater method is being proposed to grow a large single crystal of type VIII clathrate intermetallics. For the single crystal growth, magnetic stirring in the zone will be employed. This method will be effective in obtaining higher figure of merit by lowering thermal conductivity and increasing electric conductivity. By investigating produced $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$ using differential thermal analysis, XRD and microstructure characterization, phase diagram for $\text{Ba}_8\text{Ga}_{16}\text{Sn}_{30}$ will be determined.

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