CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Objective 1 of this study has been achieved where thermoelectric samples were successfully fabricated using a low-cost hot press machine. From the study, it can be concluded that the preparation of samples using AM method produces samples closer to targeted stoichiometry samples, which has been confirmed further with EDS results. Optimization of the sample's fabrication could be achieved at a temperature of the higher melting temperature of dopant, longer pressing time and higher pressing pressure.

Objective 2 of this study has been achieved where improvise the design of the in-house vacuum chamber apparatus for high-temperature measurement based on Nadhrah M. Y., (2012) initial design. This apparatus is built to allow Seebeck measurement at lΔT. A heat flow meter made of tungsten is used to replace a brass heat flow meter to ensure that a higher temperature of heat above 540 K can flow through the heat flow meter without becoming bent. The repetitive results of measurement inside the vacuum chamber have been confirmed with the measurement at the outside chamber.

Objective 3 of this study has been achieved where lΔT measurement of BiTe samples has successfully been made using the improvised in-house design vacuum chamber. Seebeck of each sample differs significantly depending on the composition of the samples. In comparison, Seebeck at sΔT has been compared with literature which

fulfils the expectation that fabricated samples using HP produce lower Seebeck compared to well established SPS method. However, the results of electrical resistivity of samples measured with a 4-point probe agree well with the literature.

Objective 4 is achieved when comparison has been made between sΔT and lΔT shows a significant difference from Seebeck. This agrees well with the previous study where $ZT = \frac{\alpha^2}{\rho\lambda}$ of the sample differ under lΔT compared to measurement under sΔT. One of the factors might be attributed to this Seebeck coefficient.

5.2 Recommendations

Further study can be improved using the following recommendations:

1. Use ball milling to mix the powders instead of hand-stirring before pressing it to form a bulk sample to blend powders well and reduce the grain size into fine powders. In this study, hand stirring was used to mix the powder. The use of ball milling will improve the homogeneity of the thermoelectric sample.
2. To measure thermoelectric properties such as the Seebeck coefficient under a small temperature difference, a thermoelectric module or heating material need to be used on the cold side so that the side can be heated up to reduce the temperature difference between the hot and cold side. The use of a regulator or transformer will make it easier to control the temperature output from the heater. PIC controller may be the best choice to be used for controlling the temperature of the power supply.
3. Shortening the length of the tungsten rod of the heat flow meter can reduce the heat loss to the surrounding during the heating process of the hot side of the sample. The heat loss to the surroundings was larger as the temperature of the heater increased.
4. Clean the sample thoroughly using sand paper then wash it with acetone and dry the samples before each measurement to ensure the sample is clean from the oxidised layer on the surface. In this research, the samples were only cleaned up using sand paper.