CHAPTER 5

CONCLUSION AND SUGGESTIONS

In this thesis, we studied development of temperature sensor by thermoelectric cell for industry. The powder of Bi, Sb and Te were mixed in planetary ball mill 350 rpm for 10 h under argon atmosphere. The hot press in a cylindrical graphite at 673 K under 60 Mpa for 1 h in vacuum, and apply to temperature sensor in Korn Det industry. The properties of Bi_2Te_3 and $Bi_{0.4}Sb_{1.6}Te_{3.4}$ material have been investigated further viz physical properties, crystal structure and microstructure, and thermoelectric properties. Conclusions based on the finding of this thesis are as follows:

CONCLUSION

The powder of Bi and Te were mixed in planeraty ball mill and successfully synthesis by HP method. The crystal structure of sample shown single phase and hexagonal structure. The lattice parameter and density of the sample have value similar literature data. The SEM image shown the morphology of the as–prepared Bi_2Te_3 powder, which had an uneven distribution of particles, size 5 and Bi_2Te_3 bulk samples, after sintered by HP method. The S of Bi_2Te_3 shown negative value indicate that an n–type. The S value of sample was decreases with increasing temperature from –155.920 V K^{-1} at 325 K to –123.65 V K^{-1} at 525 K. The ρ were measured in the temperature range of 325 – 525 K. The ρ values of the Bi_2Te_3 sample are 20.347 x $10^{-5}\Omega$ m at 325 K to 13.8878 x $10^{-5}\Omega$ m at 525 K. The κ values of the Bi_2Te_3 sample are 1.8493 W m^{-1} K^{-1} at 325 K to 2.3579 W m^{-1} K^{-1} at 475 K. A maximun ZT values of Bi_2Te_3 sample are 0.025 at 475 K.

The powder of Bi, Sb and Te were mixed in planeraty ball mill and successfully synthesis by HP method. The crystal structure of sample shown hexagonal structure. The S of $Bi_{0.4}Sb_{1.6}Te_{3.4}$ shown positive value indicate that an p–type. The S value of

sample was increases with increasing temperature from 156.3379 μV K^{-1} at 325 K to 159.0197 μV K^{-1} at 375 K after that was decreases with increasing temperature. The ρ were measured in the temperature range of 325 – 525 K. The ρ of $Bi_{0.4}Sb_{1.6}Te_{3.4}$ sample was increased with increasing temperature indicate of semiconductor behavior. The ρ values of the $Bi_{0.4}Sb_{1.6}Te_{3.4}$ sample are 0.044 mΩ at 325 K to 0.051 mΩ at 525 K. The κ values of the $Bi_{0.4}Sb_{1.6}Te_{3.4}$ sample are 2.0089 W m^{-1} K^{-1} at 325 K to 2.0528 W m^{-1} K^{-1} at 475 K. A maximun ZT values of $Bi_{0.4}Sb_{1.6}Te_{3.4}$ sample are 0.107 at 475 K

The process of fabrication thermoelectric series cell by using p–$Bi_{0.4}Sb_{1.6}Te_{3.4}$ and n– Bi_2Te_3 bulk materials. Cutting Bi_2Te_3 and $Bi_{0.4}Sb_{1.6}Te_{3.4}$ materials were 2×2×2.5 mm3 for making series cell. The output voltage has increased with increasing temperature. A maximum of 0.03 mV at 49 K per 1 pair, the electrical power has increased with increasing temperature. The maximum value of electrical power is 0.9 mW at temperature difference around 47 K per 1 pair.

The temperature sensor, we fabricated thermoelectric cell and setup to Arduino program, and using WIFI system as a transmitter signal to laboratory. In this work use thermoelectric cell 16 pair for detect temperature and Arduino program 4 system for transmitter signal in Korn Det industry.

SUGGESTIONS

1. The Bi_2Te_3 and $Bi_{0.4}Sb_{1.6}Te_{3.4}$ sample should be improved were melted in an encapsulated quartz ampoule

2. The temperature sensor should be improved for wiring techniques, and measured sensitivity analysis of temperature sensor.

3. The thermoelectric appication should be improved the stability of system working