CHAPTER 5

CONCLUSIONS

A new polymeric system based on the ternary mixtures of benzoxazine, epoxy, and phenolic novolac resins was synthesized. The polymer shows promising characteristic suitable for microelectronic applications as underfilling encapsulation and other highly filled system. The material properties include high thermal stability, high glass transition temperature, and low melt viscosity, which are dependent on the composition of monomers in the mixture. The addition of epoxy to benzoxazine network greatly increases the crosslink density of the materials and strongly influences its mechanical properties. The phenolic novolac resin acts as an initiator for this ternary system by reducing the curing temperature of the system.

Curing behavior of these systems are investigated by DSC and FT-IR spectroscopy. As temperature increasing, the ring-opening reaction of benzoxazine with phenolic novolac resins takes place at the initial of reaction. Then the phenolic hydroxyl groups generated by the ring-opening reaction of benzoxazine react with epoxide rings. And the finally, the polybenzoxazine homopolymerization occurs. According to DSC results, the curing reaction of BEP352 is the first order kinetics. The average activation energy is approximately 97.22 kJ/mol. In the case of FT-IR experiments, the oxazine rings open and the tri-substituted benzene rings backbone become tetra-substituted benzene ring. The ring-opening of benzoxazine monomer is investigated by the significant decrease of absorbance at 946 cm^{-1}. It is found that the ring-opening of benzoxazine is the first order reaction with the calculated rate constant (k) of 0.1095 sec^{-1}.