HEALING BEHAVIOR OF DGEBA EPOXY CURED WITH A CYCLOALIPHATIC DIAMINE

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Healing in polymer thermoset systems have been carried out using the reversible chemistry of Diels-Alder reactions [1], catalyst/monomer inclusions that cause autonomous healing [2] or polymer composites comprised of a thermoset and a linear polymer [3]. There have been very limited studies so far into the healing characteristics of unmodified thermosetting polymers [4].

In this work, the healing behavior of thermosets formed by reacting a difunctional epoxy, diglycidyl ether of bisphenol A (EPON®828) and a tetrafunctional amine, 4,4’ methylenebiscyclohexanamine (AMICURE®PACM) both at and off stoichiometry is investigated. After postcure and complete fracture, these thermosets exhibit the ability to regain their load bearing capacity to various degrees at temperatures above the glass transition temperature. The effects of temperature, pressure and stoichiometric ratio are studied here. Load recovery of approximately 60 percent is observed at stoichiometric ratio and this and other values of recovered load are found to depend on the conditions employed for healing. Increasing the pressure applied on the specimens resulted in increased load recovery as did an increasing temperature. Visual inspection of specimen crack interfaces suggests that the crack has disappeared. Scanning electron micrographs of fractured and healed sections of the specimen suggests that there may be a diffusible sol-phase that lends strength at the crack interface and the higher load recovery of samples that are significantly off-stoichiometry tend to support the observation. On the other hand, secondary chemical reactions at elevated temperatures cannot be ruled out at this point. Our results show that an unmodified thermosetting system can exhibit healing behavior similar to other healable thermosets. The conclusions drawn in this work also lead us to believe that there may be more than a single effect responsible for observed healing phenomena in thermosetting polymer systems.

REFERENCES

