Microwave-assisted Homopolymerization of Epoxy Resins and their thermal Properties

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Abstract

Microwave radiation has been extensively employed as an auspicious alternative energy source to conventional thermal heating and also widely investigated in various scientific research fields[1],[2]. Due to their higher efficiency compared to reactions conducted with conventional heating, microwave-assisted chemical syntheses have garnered considerable attention in recent years. The potential ability of microwave radiation to induce polymerization reactions has also been investigated[3],[4]. Henningsen et al. reported the usage of microwave radiation as processing tool for anhydride curing and metal-complex initiated polymerization of epoxy resins[5]. They found that comparable results could be obtained using microwave heating, thermal heating and electron beam processing. In this study we wish to report on new findings in microwave processing for epoxy resin curing via cationic and anionic homopolymerization. Besides two initiators for cationic polymerization the ability of imidazolium salts (IMs) to induce anionic polymerization in the microwave oven was also studied. In previous work we found that resin systems reinforced with carbon based fillers exhibited a more homogeneous temperature distribution in the curing process. Therefore, in this study diglycidyl ether of bisphenol A (DGEBA) and its mixture with small amounts of carbon black or graphite as fillers were chosen as test systems to evaluate the activities of the curing agents. As reference, all the microwave hardenings (MWH) were repeated with thermal heating (TH). The thermal properties of the cured samples, such as glass transition temperatures (T_g) were evaluated by differential scanning calorimetry (DSC). It is to be noted that the T_g values depend highly on the reaction conditions. The reinforced fillers and curing agents as well impact the thermal properties of the cured materials. Improvements on T_g were observed in all samples cured with silver complex, irrespective of cure routes.

References

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