Application of a rheological technique in a light-activated dimethacrylate system: Time-Temperature-Intensity-Transformation (TTIT) cure diagram

Jong Keun Lee, Ju Yeol Choi

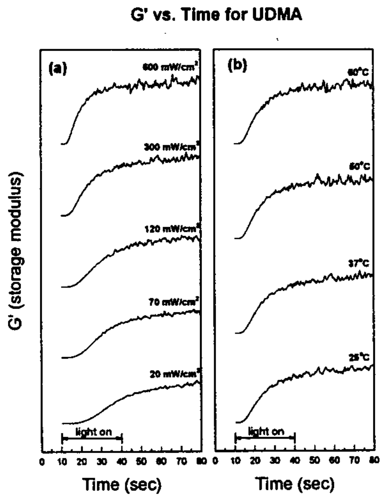
Department of Polymer Science and Engineering, Kumoh National Institute of Technology, 188 Shinpyung Dong, Kumi, Kyungbuk, 730-701

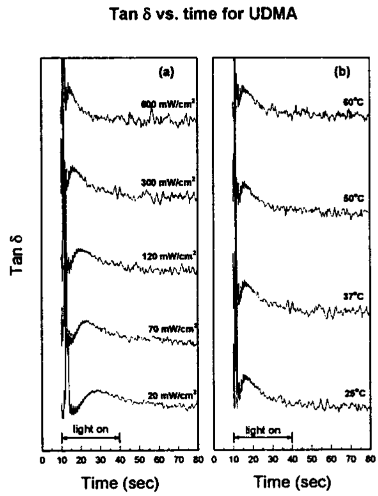
Introduction

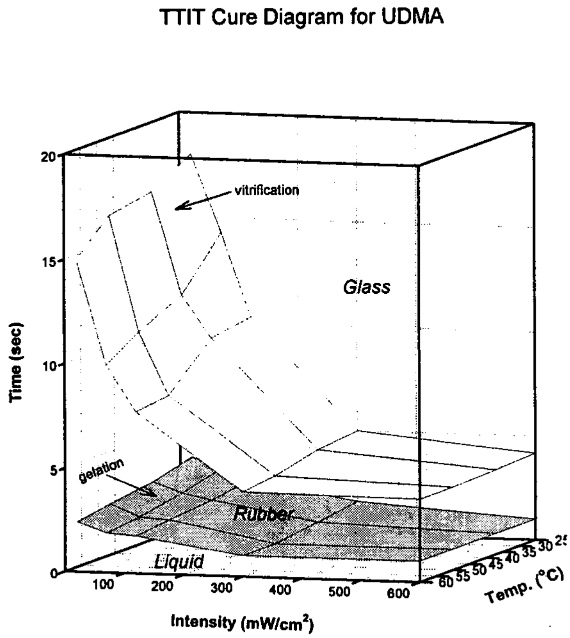
Since final properties after cure are closely related to the details of cure process, understanding cure process could be especially significant to improve performance qualities in network forming systems. During forming network, extreme changes take place not only molecularly from monomers to highly crosslinked polymer but also macroscopically (rheologically) from the fluid state prior to gelation to the glassy state after vitrification. Dramatic rheological changes during the network formation are considered to be of great importance in characterizing and understanding the cure process. Useful information for ultimate final properties and performance of material can be obtained from the rheological study during the changes.

Dynamic mechanical analysis (DMA) is a versatile technique that may be used to simultaneously characterize both rheological and thermal properties of a wide range of sample types [1]. One of achievements of dynamic mechanical studies in thermosetting resins is the time-temperature-transformation (TTT) cure diagram from the work of Gillham and Enns [2-4]. The TTT cure diagram, established by means of a freely oscillating DMA technique-Torsional Braid Analysis (TBA), is recognized as a basis for analyzing and designing cure processes, describing the various physical states of a thermosetting material during isothermal cure reaction. The cure process was characterized by the resin rheology as a function of time and temperature based on the two phenomena of critical importance; gelation and vitrification.

As for the thermosetting materials, it is essential to investigate the cure behavior of photoinitiated systems. In this study, we intend to employ a DMA technique, which is capable of *in-situ* monitoring rheological properties during cure, and develop time-temperature-intensity-transformation (TTIT) cure diagram for two different dimethylacrylate resins activated by visible light. The cure diagram can be used to track the effect of light intensity on the physical state of the network forming material coupled with cure time and temperature in photoinitiated systems.







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