Effects of curing conversion on properties of benzoxazine-urethane shape memory polymer alloys

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Abstract: Shape memory polymers (SMPs) are a class of smart material that shows reversible recovery or reversible restoration of its deformed state to its original shape and are an expanding field in polymer science related to numerous smart application. The purpose of this research is to study effects of curing conversion of benzoxazine (BA-a)/urethane (PU) copolymer (at 60/40 mass ratio) at various curing times on its shape memory performance. The conversions of BA-a/PU copolymer were evaluated by differential scanning calorimetry (DSC). Thermal and mechanical properties of the copolymer were investigated by thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA) and universal mechanical testing (flexural mode). Glass transition temperature ($T_g$) of BA-a/PU copolymer was expectedly increased with increasing conversion. Shape fixity of the copolymer were 97-99% and shape recovery were found at 97-98%. Flexural strength and modulus of the copolymer were systematically improved at higher conversion. These results revealed that BA-a/PU copolymer at curing conversion of about 75% provided good balance properties to serve as shape memory polymer.

Keywords: Shape memory polymer; Benzoxazine; urethane; Copolymer