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THERMOPLASTIC-THERMOSET CO-CURED HOMOGENEOUS NETWORK OF PEEK-ALDERENE POLYMERS AS HIGH PERFORMANCE MATRIX FOR SPACE APPLICATIONS

Abstract

Thermoset resins based on bismaleimide (BMI) chemistry possess many desirable properties required for high performance polymer matrices.Nonetheless, these systems are not exempted from the inherent brittleness.brittleness. Allyl functional monomers and polymers are known to act as reactive diluents of BMIs to improve the processability and toughness of the resultant resin, rendering the system better suited for high performance composites.This paper reports a novel tough and homogeneous thermoset-thermoplastic co-cured Alder-ene network from O-Allylaralkyl phenolic resin (OAX) and bismaleimides (BMIs) by co-reacting with a telechelic polyether ether ketone bearing allyl end groups (PEEKMA).PEEKMA was synthesized via nucleophilic substitution of allyl bromide with the corresponding phenol-telechelic precursor- polyether ether ketone (PEEKOH). The telechelic allyl moiety co-reacted with bismaleimide through Alder ene reaction to form a homogenous, inherently tough matrix.The paper attempts a systematic assessment of the effect of PEEKMA on the thermal and mechanical properties of the Alder ene networks of two types of BMIviz. 2, 2'-bis 4-[(4'-maleimido phenoxy) phenyl] propane (BMIP) and 4, 4'bismaleimidodiphenyl methane (BMPM) with OAX and their composites.The co-reaction of PEEKMA with BMI is confirmed by DSC through the ene reaction initiation around 100 C, without altering the cure profile of the BMI-OAX blends.PEEKMA addition up to 5 wt % helped to improve the cross-link density of the cured polymer network beyond which a reverse trend was observed.Only one transition peak in the Tan curve was seen in DMA indicating absence of phase separation.All combinations of the blends with PEEKMA retained the inter-laminar shear strength (ILSS)to more than 50% at 150C indicating the good inter-facial adhesion with PEEKMA.Retention of ILSS at elevated temperature was better for the BMPM system compared to BMIP. Upon PEEKMA addition, the impact strength was also ameliorated by 38% for BMPM based composition while for BMIP the increase was by 67%.A uniform phase morphology of the PEEKMA incorporated cured Alder ene blends was confirmed by AFM and SEM analyses. Increase in maleimide concentration transformed the smooth morphology of the cured blends to rough texture.Incorporation of PEEKMA resulted in good inter-facial adhesion at lower concentrations whereas higher proportions resulted in the formation of agglomerates.The results indicate that the novel method of reactive toughening of BMIs with PEEKMA is an effective approach for reducing the brittleness and improve the high temperature applicability of these matrices.