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EFFECT OF POSS-MODIFIED WITH AMINO GROUPS ON THE CURING BEHAVIOR AND DYNAMIC MECHANICAL PROPERTIES OF EPOXY RESIN CURED WITH DIFFERENT HARDENER

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Introduction

Research of organic-inorganic hybrid materials, with inorganic phase dispersed on molecular or nano level in polymer matrix, has gained widespread attention in recent years. It is expected that increasing interaction between phases in hybrid materials, where inorganic phase is often covalently bonded with the organic polymer, it will result in superior properties compared to classical composites.[1-2] Epoxy resins are a class of important thermosets, which have been widely used as matrices of composites materials adhesives, and electronic encapsulating materials due to their high mechanical strength, excellent chemical resistance and simplicity in processing. The addition of polyhedral oligomeric silsesquioxane (POSS) could improve other properties such as thermal stability, adhesive properties and glass transition temperature.[3] The aim of this work is to prepare POSS modified with amino groups and to evaluate the effect of the concentration of the POSS on the curing behavior and dynamic mechanical properties of epoxy hybrid materials cured with different curing system; based on aliphatic amine (room temperature curing system) and hexahydrophthalic (which requires higher curing temperature) .

Experimental Part

POSS-NH2 was obtained via hydrolysis and condensation of 3-amino propyl-triethoxysilane in THF at pH=3, using an aqueous solution of HCl. The reaction was performed at 40°C for 24, using magnetic stirring. After, the product, a white solid, was dried under vacuum at 80°C, to withdraw the residual solvent. The dried POSS in the form of a powder was dispersed in the epoxide resin, with the help of an intensive mixer, ultra-turax, at 2,000 rpm during 45 min at 60°C. The epoxide was cured with triethylene tetramine and with hexahydrophthalic anhydride. The gel time was determined using an AR2000 rheometer (TA Instruments), disposed with parallel-plates with a 25mm diameter. It was used a gap of 0.5 mm, a frequency of 1Hz.

Results and Discussions

Fig. 1 compares the viscosity versus time of pure epoxy / theta system with those modified with 1% and 3% of POSS. The presence of POSS accelerates the curing process of the epoxy network, probably because the presence of amine groups which also act as a curing site. Similar behavior was observed in anhydride curing system. Increasing the amount of POSS decreases the gel time. Figure 2. Illustrates the loss modulus epoxy/ Theta system containing 1% and 3% of POSS and cured with 13phr (T13 series) and 15 phr (T15 series) of theta. Note that for lower amount of Theta, the additional of POSS decreased the glass transition temperature. This behavior was different with higher amount of Theta.

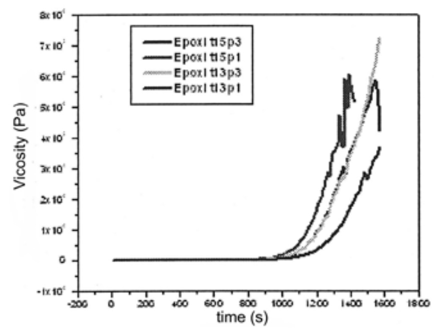

Figure 1. Viscosity vs time of epoxy/theta system.

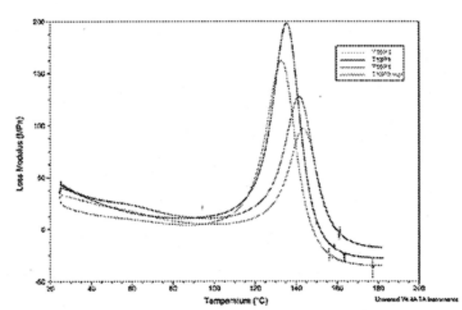

Figure 2. Loss modulus of epoxy/ theta system as function of the POSS concentration and amount of hardener.

Conclusions

POSS-NH2 constitutes a very interesting modifier for epoxy resin. The presence of low amount of POSS result in a decrease of the glass transition temperature. The material is also transparent indicating the nano structure of the hybrid material.

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References

1. Dodiuk, H.; Kenig, S.; Blinsky, I.; Dotan, A. Buchman, A. Int. J. Adhes. Adhesives 2005, 25, 211.
2. Zhang, Z.; Aijuan, G.; Guozheng, L. Penggang, R. Jianquiang, X.; Wang, X. Polym. Degr. And Stab. 2007, 20, 1.
3. Provatas, A.; Matisons, J.G. Trends Polym. Sci. 1997, 5, 327.