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Fluoropolymer Addition to an Epoxy-Amine System: Fluorinated Acids

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Abstract – Fluorinated epoxy amine networks were synthesized by reacting one of the monomers with a fluorinated acid. Miscibility curves, contact angle, friction coefficient and water absorption were analyzed as a function of fluorine content (wt %).

Fluorine containing networks were synthesized using Diglycidyl ether of bisphenol A (DGEBA) and Jeffamine D230 as precursors. A two steps curing was used. In a first step a known excess of one network precursor was reacted with a fluorinated acid, in the second step the other precursor was added in final stoichiometric ratio R=1 (epoxy /amine).

Different products were obtained depending on the reaction experimented by the fluorinated acid and the corresponding network precursor. The product of the reaction between fluorinated acid and Jeffamine D230 is ionic (ammonium salt), whereas the reaction product of the same acid with the epoxy produced a covalent bond.

Phase separation was observed in the mixtures monomer/fluorinated monomer before starting the second step. With the aim of achieving one-phase system a miscibility curve was experimentally obtained. As an example, the miscibility curve for the fluorinated epoxy system (DGF) is shown in Figure 1. The one-phase region is located above the curve. Increasing the weight percent of fluorinated monomer leads to an increase in the temperature required to generate a one-phase mixture. In order to reduce the curing temperature in the second step, 10 to 20 wt% tetrahydrofuran (THF) was used as solvent of the reactants. As can be seen in Figure 1, THF addition greatly improves miscibility.

Different properties of final materials were analyzed. Water absorption was measured for both fluorinated networks. As expected, the fluorinated polymers seem to adsorb less water when comparing with the neat system at the same temperature.

In addition, preliminary results of the measured friction coefficient showed a remarkable lowering of it for networks containing only 3 wt % F.

As shown in Figure 2, static contact angle of the fluorinated networks was determined employing different probe liquids. Networks obtained from the reaction between the fluorinated acid and the amine showed water contact angles lower than the neat system (without fluorine addition). On the other hand, the water contact angle for networks prepared by reaction between the fluorinated acid and the epoxy monomer was significantly higher. These results are probably due to the nature of the bonds generated during the first step. The resulting bromonaftalene contact angle of both kind of network increased when comparing with the neat system (See Figure 2).

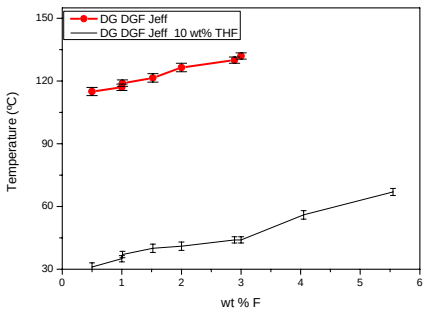

Fig 1

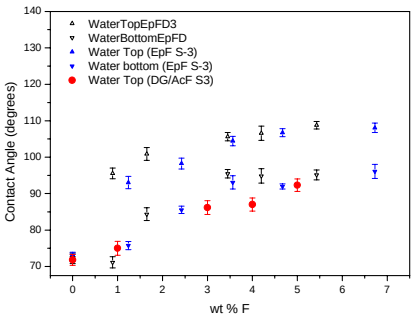

Fig 2