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New DGEBA-based epoxy resins toughened with liquid silicones

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Statement of the Problem: Epoxy coatings topic is experiencing a continuous renewal and still presents a great potential to produce new advanced functional materials exhibiting self-healing, shape memory or other functional properties such as transparent-to-opaque transitions. Epoxy coatings can be widely formulated by tailoring the epoxy resin/hardener partners upon the performance requirements for the end product. However, these materials exhibit naturally low impact resistance because of their high crosslinking density. The usual approach to toughen epoxy thermosets is to add either elastomers or thermoplastic modifiers, but this is also lowering their overall mechanical performances. Methodology & Theoretical Orientation: New epoxy-silicone coating formulations are proposed based on diglycidyl ether of bisphenol-A epoxy resin (DGEBA) and 5-amino-1,3,3-trimethylcyclohexanemethanamine (IPDA) as hardener. Several block and grafted copolymers with a silicone part were added to the epoxy matrix or to epoxy-silicone blends, at different silicone contents. Their effect on the morphology and dispersion effectiveness was studied by scanning electron microscopy (SEM). The influence of liquid silicone inclusions on epoxy curing kinetics and on final thermomechanical properties of epoxy-modified networks was investigated using differential scanning calorimetry (DSC) and dynamic mechanical thermal analysis (DMTA). Thermal stabilities of the new formulations were analyzed by thermogravimetric analysis (TGA). Findings: The morphological evolution of epoxy-toughened networks was used to understand and explain the differences in curing kinetics and impact properties of the epoxy-modified networks with different contents of liquid silicone. Conclusion & Significance: A new strategy for preparing epoxy coatings was presented. Varying the chemical structure of silicone copolymers allows tailoring the morphology and morphological evolution of the silicone inclusions during curing and so, the impact resistance of the epoxy-silicone modified coatings.

Biography

Daniela Rusu (M.Sci., Ph.D., HDR in Materials Science) is a Polymer Scientist at the Université de Haute-Alsace, Laboratoire de Photochimie et d'Ingénierie Macromoléculaires (LPIM), Mulhouse, France. Her research and teaching activities focuses on multiphase polymer systems (polymer blends, nanostructured materials, gels, composites...), in understanding the processing-structure-properties relationships and tailoring these complex polymer materials for targeted applications (biomedical applications, food packaging, transport, coatings...). Her current research focuses on advanced polymeric materials for coating, and biodegradable polymers for medical and industrial applications. She co-authored 10 book chapters and over 100 articles on multiphase polymer systems, in different peer-reviewed journals and proceedings. She is an active referee for peer-reviewed journals and a scientific expert for EU Framework Program Horizon 2020 for Research and Innovation.

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