Microstructure and performance of block copolymer modified epoxy coatings

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ABSTRACT: Modification of epoxy coatings for higher fracture toughness and better flexibility is needed in many high-end coating applications. Appropriately designed low molecular weight block copolymers, containing "epoxy-philic" and "epoxy-phobic" sub-chains, can self-assemble into various structures in uncured epoxy resins. The resultant nano-structured thermosets exhibit remarkable toughness improvement. However, until now, studies of block copolymer toughened epoxies have been mainly devoted to bulk materials. Here, the effects of two diblock copolymers, poly(ethylene-*alt*-propylene)-*b*-poly(ethylene oxide) and poly(1,2-butadiene)-*b*-poly(2-vinyl pyridine), on the mechanical properties of epoxy coatings were studied. Both modifiers formed spherical micelles of 10 – 20 *nm* diameter in cured 15 μm thick coatings. Micelle segregation to the coating/substrate interface was also observed. The abrasive wear resistance of epoxy coatings significantly increased with modifier inclusion (e.g., wear resistance increased up to 40% with 5 wt.% modifier). This effect is consistent the five-fold enhancement in the critical strain energy release rate measured in bulk epoxies of the same composition. Addition of the block copolymer modifiers did not decrease the elastic modulus, hardness, or transparency of coatings.

REFERENCE:

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