ADDITION OF BLOCK COPOLYMERS TO EPOXY COATINGS:

E. Redline(*), L. Francis(*) and F. Bates (*)

(*) Department of Chemical Engineering and Materials Science
The University of Minnesota, Minneapolis, Minnesota 55455

Presented at the 15th International Coating Science and Technology Symposium,
September 13-15, 2010, St. Paul, MN[1]

Amphiphilic block copolymers have generated interest for use as toughening agents in epoxy thermosets. These polymers are added at low loadings (< 10 wt %) to epoxy monomer and are capable of self-assembling into various micellar shapes depending on the ratio of the "epoxy-philic" to "epoxy-phobic" blocks; these micelles have been shown to persist after cure and dramatically increase the fracture resistance of the thermoset with only small changes to elastic modulus and glass transition temperature.

In this work, we investigate the ability of amphiphilic diblock copolymers consisting of an "epoxy-philic" poly(ethylene oxide) (PEO) block and an "epoxy-phobic" poly(ethylene-alt-propylene) (PEP) block to toughen epoxy coatings. The PEP-PEO block copolymers were added to the diglycidal ether of bisphenol A (DGEBA), an epoxy monomer, and the hexa-functional amine crosslinker, polyether triamine (JEFFAMINE T-403). The resulting mixture was diluted in toluene and coated onto glass substrates using wire-wound rods. Mechanical properties as a function of coating thickness were determined using nanoindentation and compared to the bulk.

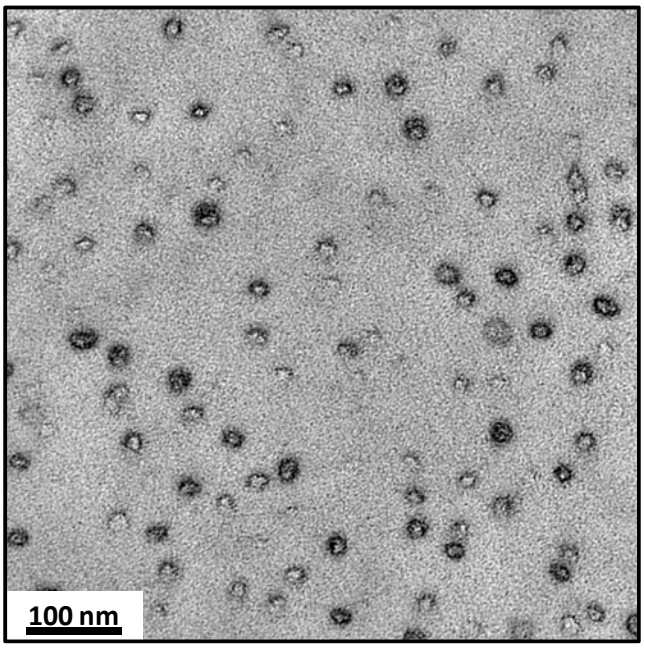

Figure 1. A TEM micrograph of EPON 828/JEFFAMINE T-403 epoxy containing 4 wt. % PEP-PEO (M_n = 27,000 g/mol, M_w/M_n = 1.08, f_{PEO} = 0.57) diblock copolymer. The block copolymer exhibits a spherical micelle morphology with diameters of 20–30 nm. The sample was stained with RuO_4, which preferentially stains PEO > epoxy > PEP.

[1] Unpublished. ISCST shall not be responsible for statements or opinions contained in papers or printed in its publications.