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Polymer Diffusion and Cross-linking in Thermoset Latex Films

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For many years the coatings industry has been interested in latex films that undergo cross-linking after the coating is applied to a substrate. Under ideal circumstances, cross-linking converts the resin part of the coating into a single giant molecule. Latex films are formed by the coalescence of individual polymer (latex) particles with diameters on the order of 100 nm. In the newly formed film, there are boundaries between adjacent particles. Film strength comes from the diffusion of polymer molecules across these boundaries. This strength is enhanced by cross-linking. In thermoset latex films, polymer diffusion has to occur much faster than the chemical reaction that leads to cross-link formation. We are interested in examining this competition for different latex polymers and for a variety of crosslinking chemistries. I will introduce this topic and then focus my talk on a system consisting of a mixture of two types of reactive latex particles, one containing carbodiimide groups and the other, carboxylic acid groups. In films of their blends, the two polymers are only partially miscible. By energy transfer measurements, we determine the thickness of the interface between the two polymers as a function of composition, and show how the reaction between the two functional groups drives the mixing of the two types of polymers. At relatively low temperatures, the groups react so quickly at the interpolymer boundary that mixing of the two polymers becomes limited.