

Film formation and structure of waterborne polyurethane-acrylic nanocomposite adhesives

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Abstract

Nanocomposite latex particles consisting of an acrylic copolymer and a pre-formed resin with urethane functionality have been prepared by miniemulsion polymerisation. We will report the effects of the particle characteristics (especially the gel content, crosslinking density, and grafting) on the structure and drying characteristics of the resulting adhesive films. Atomic force microscopy (AFM) of individual particles showed that the extent of particle deformation is inversely correlated with the crosslinking density. The films displayed a loss of optical transparency (attributed to phase separation of polyurethane and acrylic) as the amount of grafting of the urethane to the acrylic copolymer was decreased, which is consistent with the appearance of a second phase in AFM images of film cross-sections. The effects of both the crosslinking density and the grafting on the drying characteristics of the films were investigated by magnetic resonance profiling. A strong non-uniformity in the water distribution, which indicates skin formation, was found in those systems in which the polyurethane was not grafted to the acrylic polymer. These results clearly show that the crosslinking density and the amount of grafting of the polyurethane to the acrylic play a crucial role in determining the structure and characteristics of the resulting films.