Structural Design of Waterborne Coatings

to Control Functional Properties

J.L. Keddie,[a] I. Martin-Fabiani,[a] A. Fortini,[a] R. Gurney,[a] J. Lesage de la Haye,[b] A. Utgenannt,[a] C. Boncompain,[c] E. Bourgeat-Lami,[b] F. D'Agosto,[b] M. Lansalot,[b] and R.P. Sear[a]

a. University of Surrey, Guildford, UK
b. Université Claude Bernard Lyon 1, CNRS & CPE Lyon, France
c. Paint Research Association, Hampton, UK

Over the past couple of decades, as the demands for low-VOC coatings have grown, there have been intensified efforts to improve the properties of waterborne coatings and adhesives. This class of coating relies on the film formation process, in which stable polymer colloids are transformed into a cohesive binder. The design of a formulation (such as the selection of colloidal particle size ratios and volume ratios) and the processing conditions (such as temperature and humidity) can markedly influence the structure of a waterborne coating. In turn, the functional properties – such as adhesion, gloss, friction, and wetting – are affected by the composition and surface structure at the nanometer and micrometer length scales. In this lecture, I will review some of the progress made in using the combination of formulation and processing to achieve the desired properties. For instance, when hard polymer nanoparticles create a percolating structure in a soft adhesive, the tackiness can be "switched off" when the nanoparticles are sintered together. In optical coatings, the organisation of Au plasmonic nanoparticles within a polymer film can be adjusted to increase extinction at particular wavelengths. Our work has shown that the distribution of inorganic particles in the direction perpendicular to the substrate can be controlled through the right balance of the rates of water evaporation and particle diffusion and sedimentation. Under certain processing conditions in bimodal blends of particles, the surface layer can be depleted of large particles, which opens up possibilities to tailor the coating's functionality.

Biography

Joseph Keddie is a Professor of Soft Matter Physics at the University of Surrey. His main research area is polymer colloids and their applications in coatings and soft adhesives. He is a Fellow of the Institute of Physics and was awarded their 2001 Paterson Medal and Prize for his contributions to the understanding of polymer dynamics in thin films. His research group has won two Roon Awards from the Federation of Societies for Coatings Technology (2001 and 2007) and the Innovation Prize from Coatings Science International (2012). Prof. Keddie holds a PhD degree from Cornell University (USA) in materials science and engineering, and he spent three years as a post-doctoral researcher at the University of Cambridge. A co-author of more than 100 journal articles and a book on latex film formation, he has an *h*-index of 35.