Waterborne nanoceria/polymer nanocomposites: Enhanced properties through designed nanostructure

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In recent years nanoceria has attracted the interest of both industrial and scientific communities, because of its high reactivity and its oxygen buffering capacity. Moreover, hybrid ceria/polymer systems have shown strong UV absorbance, which are of interest for the development of protective coatings and photoactive layers in solar cells. In this work, a series of nanoceria-stabilised acrylic latex particles has been synthesized by Pickering emulsion polymerization in the absence of surfactant. All Pickering latices in the series, ranging from 0 to 10 wt.% nanoceria, are film forming at room temperature and demonstrate ordered particle packing, as revealed by atomic force microscopy. Upon film formation, the nanoceria shells of the particles create a honey-comb structure extending throughout. The nanocomposites' UV-visible spectra show strong absorption in all regions of the UV, and the linear absorption coefficient for UVA and UVB wavelengths increases with increasing nanoceria content. The presence of ceria improves the thermal and mechanical stability of the nanocomposite, by increasing its softening point and raising its elastic modulus in the rubbery state, according to dynamic mechanical and thermal analysis. These observations are discussed in the context of the honeycomb architecture formed by the soft latex particles that are surrounded by hard inorganic particles, thus giving stability to the structure. The results presented here will be of great interest for the development of both high performance coatings and photoactive layers.