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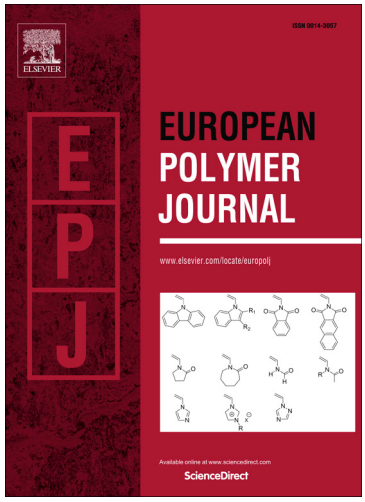

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Nanoscale Young's modulus and surface morphology in photocurable polyacrylate/nanosilica composites

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Abstract

We studied quantitatively nanomechanical properties (Young's modulus, adhesion force) and surface morphology of two types of model polymer-nanosilica composites. High-resolution structure-property maps were obtained using atomic force microscopy (AFM) in the non-resonant dynamic imaging mode (Quantitative Imaging, QI) by the collection and evaluation of a large number of force-distance curves. The Derjagin-Muller-Toropov (DMT) mechanical contact theory was applied. Interactions between the filler (Aerosil R7200) and two matrices (based on 2-hydroxyethyl acrylate and polyethylene glycol diacrylate) resulted in the appearance of differences in the interphase structure of the two types of composites. The main goal of the paper was to reveal these differences by determination of the mechanical nature of the polymer-particle interphase through systematic AFM indentations providing excellent mapping details. We focused on how the sub-microstructure of the nanocomposites is influenced by the presence of the varied filler contents. The AFM nanomechanical analysis is supported by a standard AFM imaging and SEM morphological observation as well as polymerization kinetics measurements. Our work serves to give a better understanding of the mechanical behaviour and properties of nanocomposites, particularly at the filler-matrix interphase.