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Viscoelastic analysis of silica nanoparticle-polymer nanocomposites

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Abstract. The creep behavior of polyimide nanocomposites containing silica (SiO_2) nanoparticles is investigated employing a unit cell-based micromechanical method. The interphase region created due to the interfacial interaction between polyimide matrix and nanoparticle is incorporated in the analysis. Both random and regular distributions of nanoparticles into the polymer nanocomposites can be included in the modeling. Comparison between the results of the proposed model shows a good agreement with existing experiment. The results reveal that for a more realistic prediction in the case of creep behavior of SiO_2/polyimide nanocomposites, considering the viscoelastic interphase is essential. Additionally, at a high volume fraction, it is necessary to consider the viscoelastic interphase together with random distribution of nanoparticles into the matrix for providing accurate predictions. The micromechanical model is utilized to evaluate the creep behavior of SiO_2 nanoparticle/polyimide nanocomposite under biaxial and triaxial loads.

Keywords: A. Nano-structures, B. Creep, B. Interface/interphase, C. Micro-mechanics.

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