

Investigating the Minimum RVE Size to Simulate Poly (Propylene carbonate) Composites Reinforced with Cellulose Nanocrystals as a Bio-Nanocomposite

Authors : Hamed Nazeri, Pierre Mertiny, Yongsheng Ma, Kajsa Duke

Abstract : The background of the present study is the use of environment-friendly biopolymer and biocomposite materials. Among the recently introduced biopolymers, poly (propylene carbonate) (PPC) has been gaining attention. This study focuses on the size of representative volume elements (RVE) in order to simulate PPC composites reinforced by cellulose nanocrystals (CNCs) as a bio-nanocomposite. Before manufacturing nanocomposites, numerical modeling should be implemented to explore and predict mechanical properties, which may be accomplished by creating and studying a suitable RVE. In other studies, modeling of composites with rod shaped fillers has been reported assuming that fillers are unidirectionally aligned. But, modeling of non-aligned filler dispersions is considerably more difficult. This study investigates the minimum RVE size to enable subsequent FEA modeling. The matrix and nano-fillers were modeled using the finite element software ABAQUS, assuming randomly dispersed fillers with a filler mass fraction of 1.5%. To simulate filler dispersion, a Monte Carlo technique was employed. The numerical simulation was implemented to find composite elastic moduli. After commencing the simulation with a single filler particle, the number of particles was increased to assess the minimum number of filler particles that satisfies the requirements for an RVE, providing the composite elastic modulus in a reliable fashion.

Keywords : biocomposite, Monte Carlo method, nanocomposite, representative volume element

Conference Title : ICACM 2015 : International Conference on Advanced Composite Materials

Conference Location : New York, United States

Conference Dates : June 04-05, 2015