World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:11, 2018

Micromechanical Modeling of Fiber-Matrix Debonding in Unidirectional Composites

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Abstract : Due to variations in damage mechanisms in the microscale, the behavior of fiber-reinforced composites is nonlinear and difficult to model. To make use of computational advantages, homogenization method is applied to the micro-scale model in order to minimize the cost at the expense of detail of local microscale phenomena. In this paper, the effective stiffness is calculated using the homogenization of nonlinear behavior of a composite representative volume element (RVE) containing fiber-matrix debonding. The damage modes for the RVE are considered by using cohesive elements and contacts for the cohesive behavior of the interface between fiber and matrix. To predict more realistic responses of composite materials, different random distributions of fibers are proposed besides square and hexagonal arrays. It was shown that in some cases, there is quite different damage behavior in different fiber distributions. A comprehensive comparison has been made between different graphs.

Keywords : homogenization, cohesive zone model, fiber-matrix debonding, RVE
Conference Title : ICCME 2018 : International Conference on Composite Materials Engineering
Conference Location : Paris, France
Conference Dates : November 08-09, 2018

Open Science Index, Materials and Metallurgical Engineering Vol:12, No:11, 2018 publications.waset.org/abstracts/99817.pdf