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Micromechanical modeling of delamination in composites

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Delamination is a major concern for structural reliability of composite laminates. The interfacial fracture toughness is a key parameter for delamination analysis. This toughness is not a material constant but results from the micromechanical fracture process around the interface. In current modeling practice, the variability of the fracture toughness is characterized with aid of fracture mechanics concepts. However, fracture mechanics has limited validity for this characterization as the fracture process zone is not negligibly small with respect to the structural dimensions (most notably the ply thickness). Therefore, in this work, the micromechanical fracture process that constitutes delamination is investigated numerically. A computational model with realistic representation of the micromechanics is needed for better understanding of the dissipative mechanisms in different load cases. In a first step toward fracture toughness prediction, it is shown that, with the correct matrix model, the typical mode II cracking process with hackle formation is obtained.

Keywords: Delamination, fracture toughness, micromechanics, gradient damage