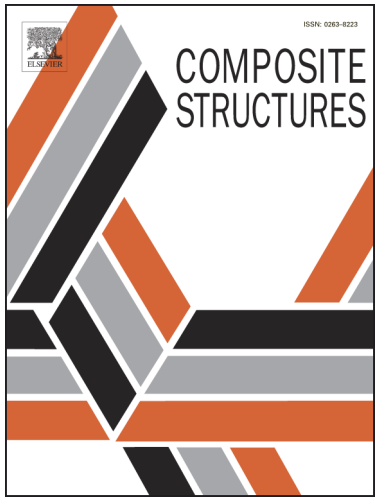

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Buckling induced delamination and microflow analysis of film/substrate system

Changguo Wang*,Jingtian Kang, Zhiming Xue, Huifeng Tan*
Center for Composite Materials, Harbin Institute of Technology, Harbin,China,150001

Abstract:

When subjected to uniformly compression, the film/substrate system will present buckling instability. With an appropriate size of pre-exiting interfacial imperfection, there will be local buckling delamination which will result in a buckling delamination induced microchannel. This microchannel has exhibited a potential application of directing and manipulating fluid flow. In this paper, we explore the on-off, evolution and failure process of the buckling delamination induced microchannel with both analytical and finite element method and investigate the flow behavior within this microchannel. We present the analytical solution to determine the critical strain for different film/substrate systems. The linear buckling analysis has been utilized to predict the buckling modes. The characteristics and configuration of the induced microchannel for different compressive strain have been investigated using nonlinear buckling analysis. The Lattice Boltzmann method has been used to study the microflow behavior within the microchannel. The theoretical and numerical buckling delamination analysis, together with the microflow analysis within the microchannel, will lay a foundation to design a flexible microvalve to regulate fluid flow where the use of traditional rigid microvalve is improper in flexible microfluidic device.

* Corresponding author
C. G. Wang, Center for Composite Materials, Harbin Institute of Technology/wangcg@hit.edu.cn
H.F. Tan, Center for Composite Materials, Harbin Institute of Technology/tanhf@hit.edu.cn