17th International Conference on Advanced Computational Engineering and Experimenting
BARCELONA, 1-5 July 2024
www.acex-conference.com

ABSTRACT:

Experimental Investigation into the Fracture Behavior of Layered Polymers

F.J. Arbeiter, C. Waly, J. Wiener, M. Pletz
Montanuniversität Leoben, Leoben, Otto-Glöckel-Str. 2, 8700, AT.

Enhancing the fracture resistance of materials through toughening mechanisms, such as leveraging the effect of material inhomogeneity, is gaining interest in both scientific research and industrial applications. Through the strategic combination of materials with varying mechanical properties, such as stiffness and yield stress, it becomes feasible to impede or halt the propagation of cracks within a structure. Consequently, this approach augments the overall energy required for the fracture of a layered material [1]. A significant downside of this approach is, that, especially in bending configurations, the overall stiffness of the layered material decreases significantly. Especially for combinations of vastly different materials, as well as for materials containing several compliant layers, this downside impacts the performance significantly – rendering the gained increase in toughness useless for engineering applications [2].
In the current work, two different approaches to circumvent this significant downside of layered materials are presented. One approach is to strategically place soft interlayers, while the bulk of the material remains of the stiffer material. If necessary criteria are met, it is possible to uphold >90% stiffness, while still significantly increasing the toughness [2]. The second promising approach shown in this work is the use of a combination of hard/soft layers and local topological constraints to uphold composite stiffness.

[1] O. Kolednik. The yield stress gradient effect in inhomogeneous materials. International Journal of Solids and Structures 2000;37(5):781–808.
[2] J. Wiener, F. Arbeiter, O. Kolednik, G. Pinter. Influence of layer architecture on fracture toughness and specimen stiffness in polymer multilayer composites. Materials & Design 2022, (219) 110828.