Crack growth along structured adhesive interfaces.

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Relevant Working Groups: WG2

Objectives / Description / Main outcomes

The aim of this STSM was develop a numerical modelling based on Finite Fracture Mechanics (FFM) to evaluate the different damage modes in adhesively bonded hybrid composite structures with very thin carbon layers. This activity was focused on the Task 2.1: 'Explore new design concepts' assigned to WG2 in the COST Action18120. To this aim the Couple Criterion (CC) technique was considered. Modern industry demands the specific design of structures tolerant to flaws. In the conception of components with crack arresters, the presence of adhesive interfaces plays a key role in such structural elements by preventing catastrophic propagation of cracks.

A literature research was carried out at the beginning of the STSM about the possible failure types and overall damage characteristics of the topic. Within this review, we focused on modelling the possible damage modes in glass/carbon UD hybrid laminates in tensile loading based on Jalalvand's experiments [*Figure 1*]. Different combinations were analyzed varying the thickness of the carbon between 2 µm to 1.2 µm to cover the whole range of damage scenarios. The main novel of the study is related to the strong singularity mechanism, when the crack in the stiff material impinges the adhesive interface with a more compliant material.

The damage development was modelled by two scenarios: (i) Glass failure, the crack penetrates the glass layer leading in second step to a global failure of the specimen [*Figure 2*]. (ii) Delamination, the crack deviates along the adhesive interface [*Figure 3*]. These results give a good understanding of how variability in the carbon layers strengths can translate into hybrid effects in composite laminates. The proposed method is validated against the experimental result. The final purpose of the STSM is to write a scientific article that would address this important topic.

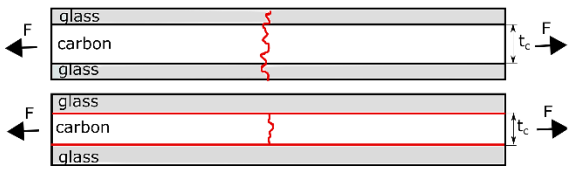

Figure 1: *Failure modes in bonded hybrid glass/carbon layers. (i) crack through the whole specimen thickness; (ii) crack in the carbon layer followed by single delamination.*

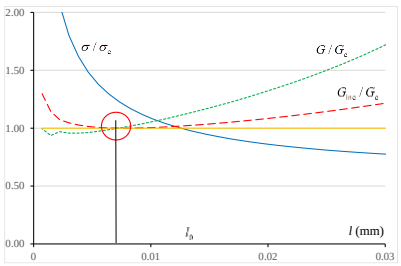

Figure 2: *The CC in the case [G/2C/G] for a crack penetrating the glass layer.*

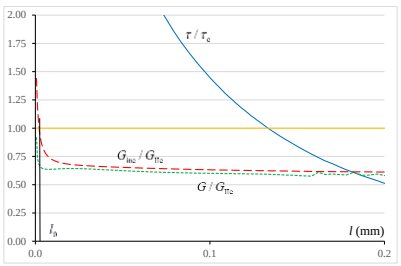

Figure 3*: The CC in the case [G/2C/G] for a crack deflecting along the interface.*

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