

# Discrete analysis of fibrillating interfaces : a multiscale approach

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# Discrete Analysis of Fibrillating Interfaces: A Multiscale approach

D. Agarwal, V. Kouznetsova, O. van der Sluis, M.G.D. Geers



European Research Council

## Background

Fibrillation is an important mechanism during copper-rubber interface delamination characterized by formation, elongation, detachment and fracture of multiple fibrils. Fig.1 illustrates the discrete complex structure of the fibrillating rubber from the copper substrate during peel test.

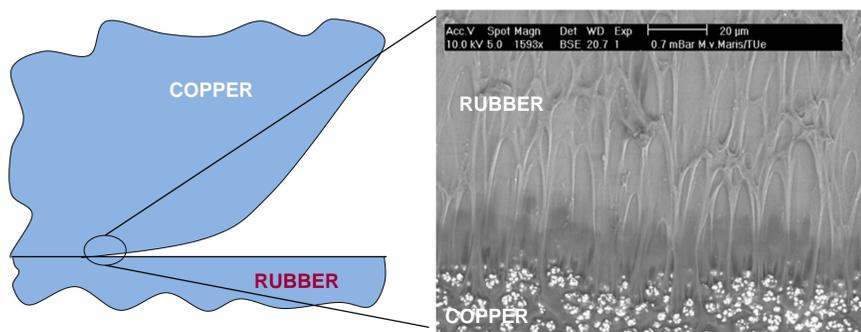


Figure 1: Schematic of cohesive zone(left) and fibrillation(right) during delamination [1]

Experimental investigations of Hoefnagels et al. [2] have shown extensive fibrillation during Copper-rubber interface delamination and a significant mismatch between the experimental results at micro-scopic level and the obtained macroscopic adhesion parameters. The fibrillation micro-mechanics was also studied computationally using a single fibril model by Vossen et al [3].

## Objective

Develop truly predictive models for fibrillating interface delamination by multiscale computational homogenisation approach with particular emphasis on the discrete nature of fibrils and the contribution of micro-scale dissipation mechanisms to the overall work-of-separation energy at macro-scopic level.

## Multiscale Analysis

Multiscale analysis is based on the concept of solving boundary value problems at two different length scales i.e. micro and macro-scopic. The mechanical response at a macro-scopic integration point is calculated based on the behaviour of underlying microstructures.

Based on the actual behavior of the fibrillar microstructures novel multiscale technique will be developed. Fig. 2 illustrates a schematic of the multiscale framework for copper-rubber interface delamination during peel test.

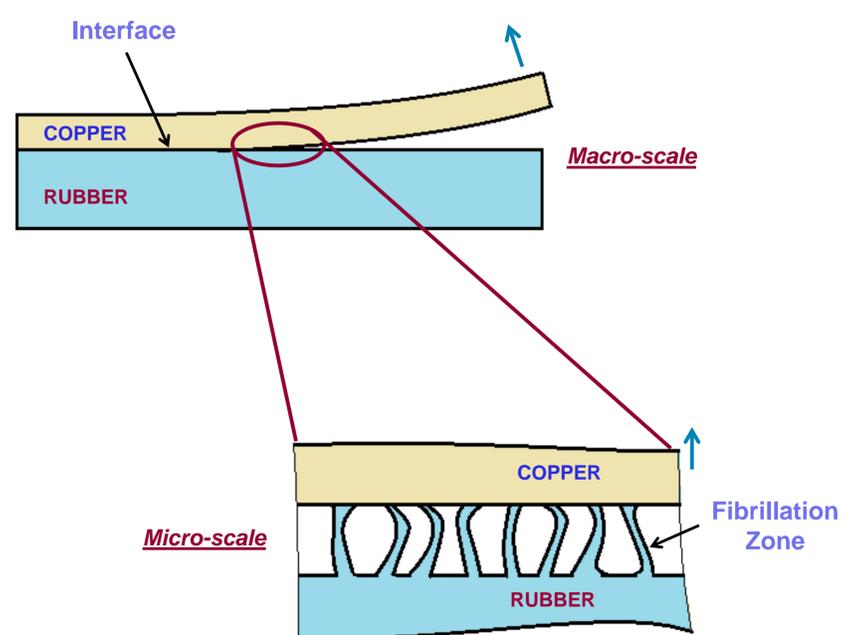


Figure 2: Schematic of Fibrillation during Interface delamination

## Outlook

Discrete modelling of fibrillar interfaces will be performed at micro-scopic level. Efforts will be made to model the interaction between individual fibrils, fibrils-substrate and also interaction between the fibrils and the surrounding bulk rubber from which the fibrillation initiates. The analysis will also include the interface separation characteristics represented by the fracture of fibrils and their detachment from the metal substrate. As a result, the contribution of dissipation mechanisms at micro-scale to the overall work-of-separation energy at macro-scale will be calculated using a multiscale approach.

## References

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2. Hoefnagels, J.P.M. et al.: *Scripta Materialia*, 2010
3. Vossen, B.G. et al.: *J. Mech. Phys. solids*, 2014