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Title: **Fracture of nano-modified adhesives and composites and beyond**

This talk will give a brief overview of the research activities of UCD Centre of Adhesion and Adhesives. It will focus on origins of fracture and toughening of nano-modified epoxy based adhesives. Although the focus is on adhesives the principles can be applied to nano-toughened polymers in general. Particular emphasis will be paid to fracture mechanisms leading to many-fold increase of fracture energy due to the additions of Core Shell Nano Particles (CSR). The synergies, of more precisely the lack of it when two families of CSRs are present will be addressed. In order to understand the basic principles behind the toughening, the latest development of micro- and multi-scale modelling in the OpenFOAM environment will be presented and discussed. The questions of how to model mm scale fracture/damage process zone evolution which consist of nm features using representative volume element approach and brain-type image processing will be addressed. The talk will then move towards the 25-year old problem on mixed-mode fracture of composite materials. Problems with analytical and cohesive zone based numerical approaches in modelling the mode-mixity will be highlighted and potential solution to the problem will be proposed.



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