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# Transition from Crack-Type to Spall-Type Failure Mode in Interfacial Debonding Under Tensile Loading

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## ABSTRACT

Brittle materials fail by means of rapid cracks. At their tips, tensile cracks dissipate elastic energy stored in the surrounding material to create newly fractured surfaces, precisely maintaining `energy balance' by exactly equating the energy flux with dissipation. Using energy balance, fracture mechanics perfectly describes crack motions; accelerating from nucleation to their maximal speed of $c_R$, the Rayleigh wave speed. A tensile crack speed greater than $c_R$ is generally considered impossible [1].

Recently, a new mode of tensile crack propagation faster than $c_R$ that is not incorporated in classical fracture mechanics has been predicted in lattice models and observed in fracture experiments on brittle hydrogels under high applied stretch [2,3]. In this talk, we present a distinct mechanism that facilitates tensile fracture beyond $c_R$. We conducted experiments and numerical simulations on an elastic plate with a weak interface under remote dynamic tensile loading [4]. The cohesive constitutive law, which describes the relationship between normal tractions and opening displacement jumps, was applied across the weak interface. Various cohesive properties were examined. A transition from sub-Rayleigh to super-Rayleigh crack propagation, or alternatively to spall-like separation, was observed during the debonding process. The results reveal that a characteristic length scale, associated with the cohesive properties, governs the transition between different debonding modes.

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