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Observation of anti-plane crack propagation

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The propagation of an anti-plane shear crack is a fundamental process linked to earthquake and fault ruptures. The stress concentration at the crack tip and its geometrical property influence the behavior of the growing rupture. However the direct imaging of such ruptures is difficult and the numerical models are limited to some approximate solutions due to the complexity of the problem.

Here we report experimental observations of direct shear crack propagation (mode III) over a heterogeneous interface. A loading force is imposed to a PMMA plate causing slow interfacial fracture propagation in mode III. The crack advance through the transparent material is monitored optically using a high-resolution camera and reveals local pinning and depinning episodes of the fracture front. We show that the crack front geometry presents fluctuations at all scales and is characterized by a constant roughness exponent. The distribution of local velocity of the crack advance is well represented by a power-law suggesting that the rupture is not growing uniformly but is rather defined by a wide variety of rupture speed. It then implies that macroscopic simulation or imaging of earthquakes and fault ruptures only represent a macroscopic or large-scale vision of the rupture process which have a rich complexity at smaller scale.