

Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
Alexandre Yersin Department of Solar Energy and Environmental Physics

Title:

The Rules of Roughness

Shmuel Rubinstein

The Racah Institute of Physics, Hebrew University, Jerusalem

Abstract:

Fracture roughness increases the surface area and is an important component of the energy budget required to advance a crack. Indeed, most fractured surfaces are rough. Rough fracture surfaces are the remnant of the tortuous path taken by the singular crack line, distorted by dynamic instabilities or heterogeneities. Despite its importance, the connection between material heterogeneity and roughness is still not well known.

Here we demonstrate that fracture roughness and heterogeneity are indeed inextricably linked through the production of step lines, a prominent constituent of the roughness present in brittle fractures, which arise from mixed (I+III) mode loading. We show that step lines are fundamental building blocks of large-scale roughness in brittle fractures. Studying the three-dimensional morphology of steps and their interactions in brittle hydrogels using confocal microscopy, the rules that govern step formation and interactions, and thus, roughness formation are uncovered. Steps nucleate at a constant rate during crack propagation and are annihilated through step interactions.

The annihilation rate grows with step density, eventually leading to a steady state number of steps. We propose a simple 1D, modified ballistic annihilation model which qualitatively captures the evolution of surface roughness.

Date & Location:

Tuesday, November 16, 2021, at 11:00
Lecture Room - Physics building (entrance floor)

