

Abstract Submitted
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Hydraulic fracture and toughening of a brittle layer bonded to a hydrogel ALESSANDRO LUCANTONIO, GIOVANNI NOSELLI, SISSA - International School for Advanced Studies, XAVIER TREPAT, IBEC - Institute for Bioengineering of Catalonia, ANTONIO DESIMONE, SISSA - International School for Advanced Studies, MARINO ARROYO, UPC - Universitat Politècnica de Catalunya — Brittle materials fracture under tensile or shear stress. When stress attains a critical threshold, crack propagation becomes unstable and proceeds dynamically. In the presence of several precracks, a brittle material always propagates only the weakest crack, leading to catastrophic failure [1]. Here, we show that all these features of brittle fracture are radically modified when the material susceptible to cracking is bonded to a poroelastic medium, such as a hydrogel, a common situation in biological tissues [2]. In particular, we show that the brittle material can fracture in compression and can resist cracking in tension, thanks to the hydraulic coupling with the hydrogel. In the case of multiple cracks, we find that localized fracture occurs when the permeability of the hydrogel is high, whereas decreased permeability leads to toughening by promoting multiple cracking. Our results [3] may contribute to the understanding of fracture in biological tissues and provide inspiration for the design of tough, biomimetic materials.

- [1] Noselli et al., *Int. J. Fracture*, 183, 241-258 (2013)
- [2] Casares et al., *Nat. Mater.*, 14, 343-351 (2015)
- [3] Lucantonio et al., *Phys. Rev. Lett.*, 115, 188105 (2015)

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