

How tip geometry controls fracture in ductile polymer glasses and brittle elastomers

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Supporting Information (SI) provides supplementary experimental details and characterization data that complement the findings presented in the main manuscript. Specifically, it includes representative stress-strain (SS) curve for the uncut polystyrene (PS) specimen till fracture, as shown Figure SI.1. Additionally, the SI details the methodology for determining the energy release rate G at fracture for the butadiene rubber (BR) system, including the experimental parameters employed for both uniaxial tension tests and pure-shear fracture tests, along with representative SS curves for the uncut BR specimens. Movie SI.1 presents a visual record of dynamic crack propagation in the BR1phr elastomer, enabling direct observation of crack growth at various load levels.

Movie SI.1 : BR1phr with pure shear geometry in uniaxial stretching tests using a crosshead speed of $V=10$ mm/min.

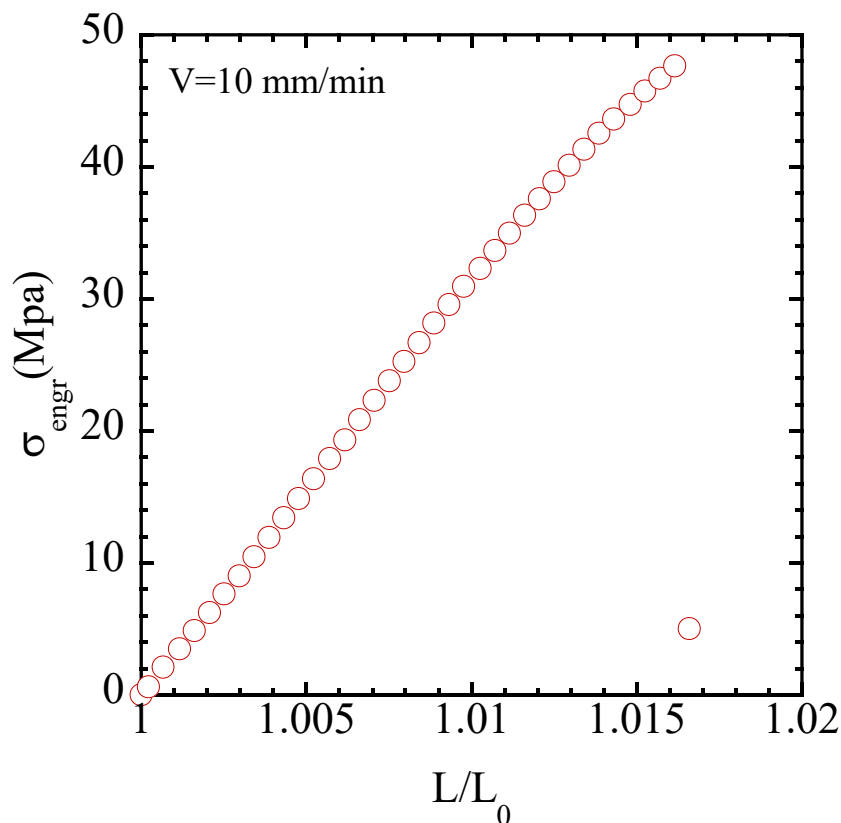


Figure SI.1 Stress-strain (SS) curve for the uncut polystyrene (PS) specimen using dumbbell shape geometry (gauge length $L_0 = 27$ mm, $B = 1.0$ mm, $W = 3.33$ mm) obtained from a uniaxial tensile test at a crosshead speed of $V=10$ mm min^{-1} .

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To determine G for the BR system, we first tested uncut specimens in tension test with an initial gauge length $L_0 = 17$ mm at a crosshead speed of $V = 10$ mm/min. We then performed pure-shear fracture tests using specimens with initial height $h_0 = 10$ mm and width $W = 70$ mm. The specimen thickness was $B = 1.5$ mm for both tests.

Reading stretch ratio at the stress maximum shown by squares in Figure SI.2, i.e., at $\lambda = 1.11$, the strain energy density W was calculated as the area under the uncut stress–stretch curve up to 1.11. The area under the circles up to 1.11 from Figure SI.2 is found to be $W = 0.021$ J/m³. Using Rivlin-Thomas formula $G = Wh_0$, we obtain $G = 0.21$ kJ/m² with ($h_0 = 10$ mm).

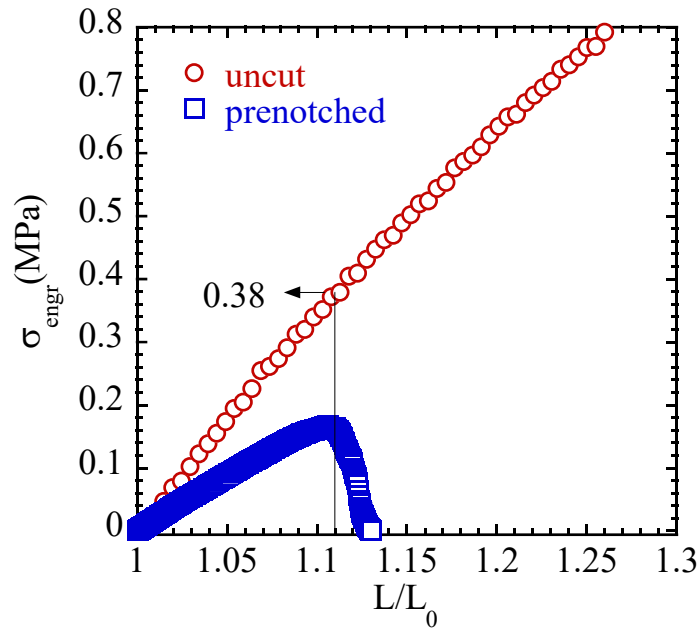


Figure SI2 Representative stress–strain response of the uncut BR specimen tested at $V = 50$ mm/min with $L_0 = 17$ mm $W=1.3$ mm and $B = 1.5$ mm. The strain energy density W is obtained by integrating the area under the curve (circles) up to the stretch ratio of 1.11 at the stress maximum.