Cutting to Measure the Elasticity and Fracture of Soft Gels

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1 Razorblade-Initiated Fracture Test, RIFT

1.1 Compliance correction

The RIFT test is a fixed displacement rate test with a displacement rate defined as $\mathrm{d}\delta_T/\mathrm{d}t$, which is defined by the crosshead speed of the instrument. The deformation of the sample (δ) is a function of the total displacement $= \delta_T$ that is measured from encoder of the instrument. To account for the deformation of the instrument, we can use the following expression,

$$\delta = \delta_T - C_M P \tag{1}$$

The machine compliance, $C_M = \frac{\Delta\delta}{\Delta P}$, is simply measured by conducting the same indentation experiment without the specimen by bringing the razorblade down into the substrate and then obtain the load (P) vs. displacement (δ) curve. Alternatively, we can measure the machine compliance from the RIFT test of a sample. As shown in Fig. (S1b), this can also be done by continually bringing the blade down into the sample past complete fracture of the sample when the blade is now indenting the stiff substrate. The inverse of the slope of this curve $= C_M$.

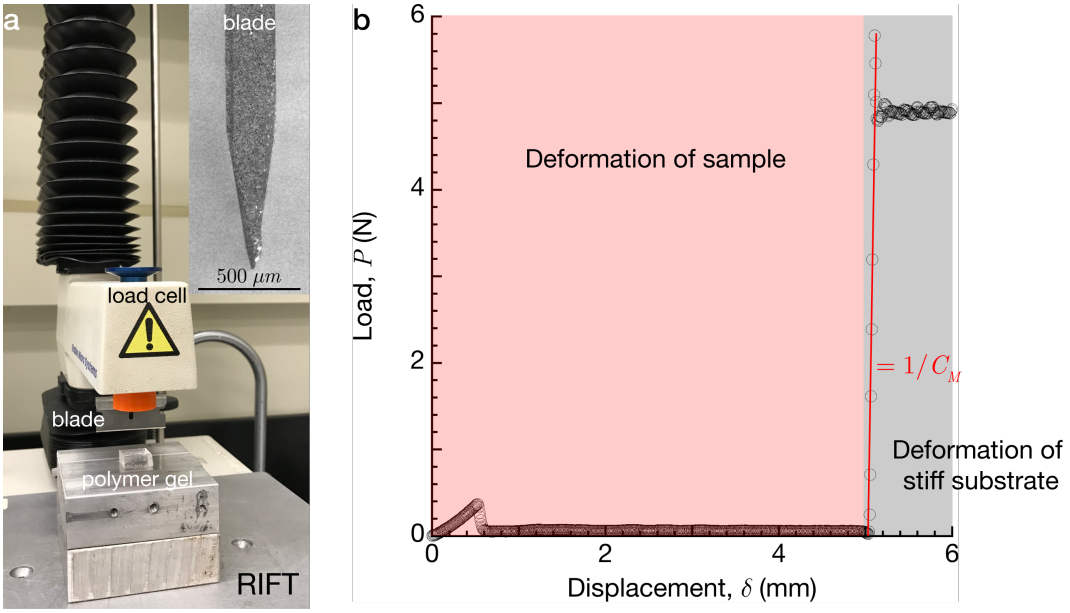

Figure S1: a) Photograph of the RIFT instrument. The tip of the razorblade was imaged with an optical profilometer. b) Complete load (P) vs. displacement (δ) curve of a RIFT test for the gellan gel.

1.2 RIFT data

Fig. S2 shows the load vs. displacement data of the RIFT measurements for the gellan gels.

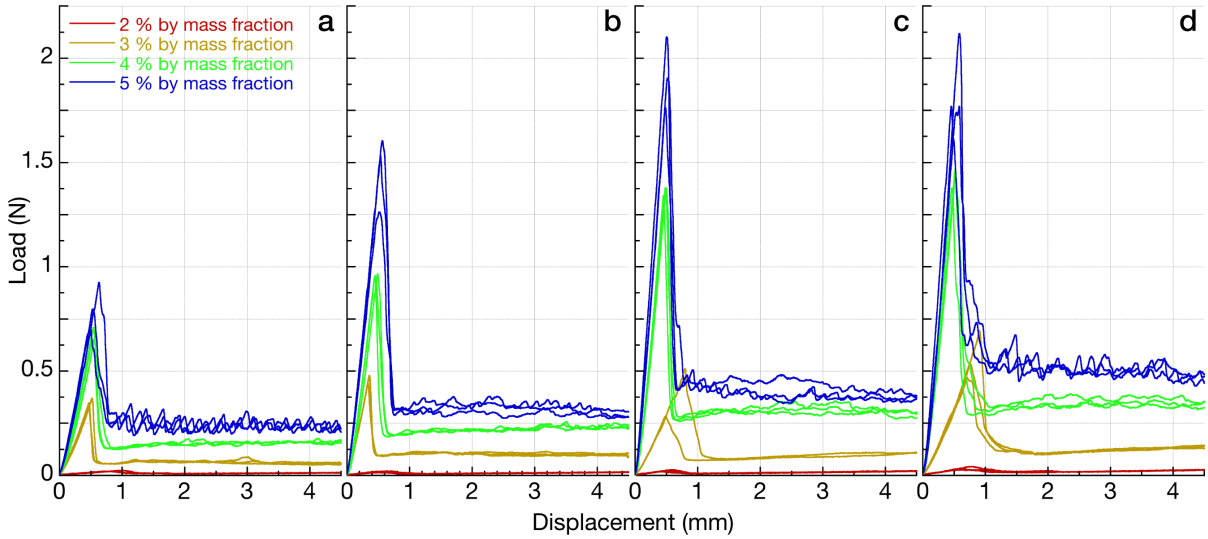

Figure S2: Load vs. displacement data from RIFT experiments for the gellan gels for crack lengths of a) ≈10 mm, b) ≈15 mm, c) ≈20 mm and d) ≈25 mm.

Sylgard 184 prepolymer components (the prepolymer and the crosslinker) were rapidly mixed in ratio of 10 to 1 by mass, poured into teflon molds of different depths, placed under vacuum for 1 h, and cured at 70 °C for 2 h.[1] Samples were removed from their molds, trimmed with a razor blade, and cut into sections of different widths. Before performing RIFT experiments, each sample was measured with calipers to precisely determine thickness and width.

Fig. S3 shows representative load vs. displacement data of the RIFT measurements for the PDMS elastomers. Here, we find that it is difficult to discern P_i and P_p due to the effects of friction.

[1] Certain instruments and materials are identified in this paper to adequately specify the experimental details. Such identification does not imply recommendation by the National Institute of Stan- dards and Technology (NIST); nor does it imply that the materials are necessarily the best available for the purpose.

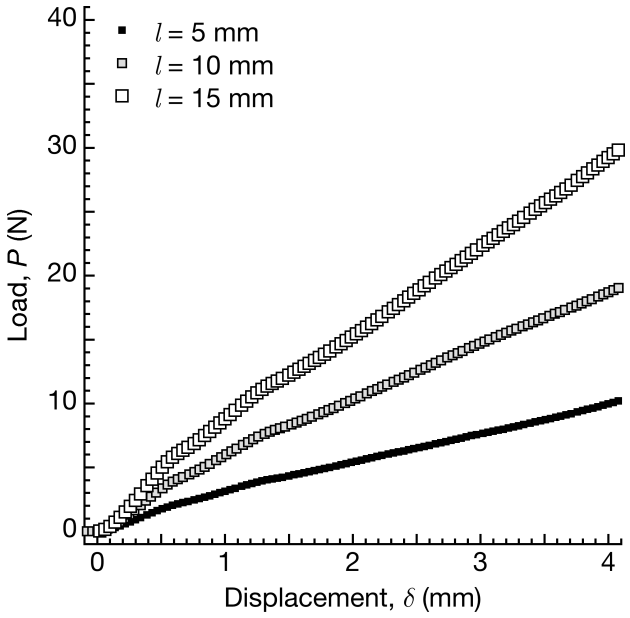

Figure S3: Load vs. displacement data from RIFT experiments for the PDMS elastomers.