Supplementary Movie 1

This movie shows that the propagation of the debond between a polyacrylamide (PAAm) hydrogel and an acrylic elastomer (VHB). The hydrogel was 3.23 mm thick in the undeformed state. A pre-crack of length 3 mm is created by placing a thin plastic film ($3\times10\times0.1mm^3$) on the interface. When the elastomer is loaded, the hydrogel film firstly deformed along with the substrate. At a critical moment the film starts to debond and the interfacial crack propagates steadily. The weight ratio of MBAA to AAm is 0.1 wt%. The tests were performed in air, at room temperature, using a tensile machine (Instron model 3342) with a 50-N load cell. The strain rate was kept constant 0.0125/s. The real-time movie was recorded at a typical rate of 30 frames/sec.

Supplementary Movie 2

This movie shows the debonding of a PAAm hydrogel film of thickness 4.5mm. The experimental condition was otherwise the same as that in Supplementary Movie 1.

Supplementary Movie 3

This movie demonstrates that the weak adhesion between the elastomer and the hydrogel still allows the bilayer to be adherent and highly stretchable, provided that the hydrogel is thin and compliant. The hydrogel was 0.1 mm thick in the undeformed state. Debond started to advance at a large stretch of λ_{cr} =2.25. The experimental condition was otherwise the same as that in Supplementary Movie 1.

Supplementary Movie 4

This movie shows the adhesion test for a hydrogel and an elastomer with nanoparticles on the interface. 20 μL of silica (Ludox TM-50) colloidal nanoparticle solution was spread on the interface between the PAAm hydrogel and VHB. The weight ratio of MBAA to AAm was 0.1wt%. The thickness of the hydrogel film is 3.23 mm. The experimental condition was otherwise the same as that in Supplementary Movie 1.