Supplemental Figure Legends

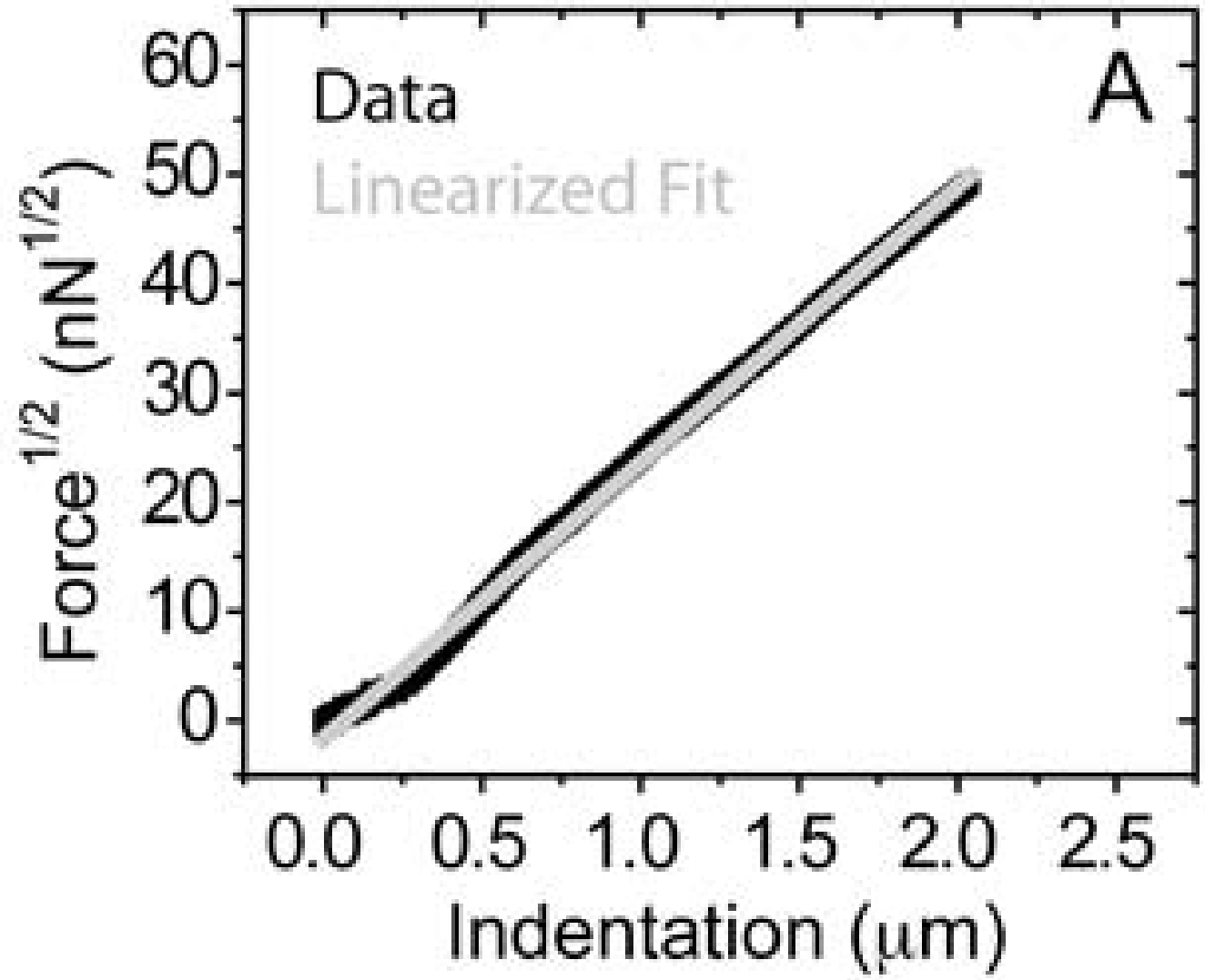
Supplementary Fig. 1: Characterization of multilayer PA Hydrogels. (A) Force spectrogram from an AFM indentation of a multilayered PA hydrogel in a region lacking a microwire. Force data has been linearized and fit with a linearized Hertz model as outlined in the Materials and Methods section. One curve was able to fit the entire data set ($r^2 = 0.998$), indicating one continuous layer at least through the maximum indentation point. (B) Confocal cross-section images of PA hydrogels containing fluorescent beads and microwires (open arrowheads) embedded in the top layer. Upon magnetic actuation, wrinkles that form are apparent from a change in fluorescent bead distribution and are highlighted by solid arrowheads. Scale bar is 5 μm.

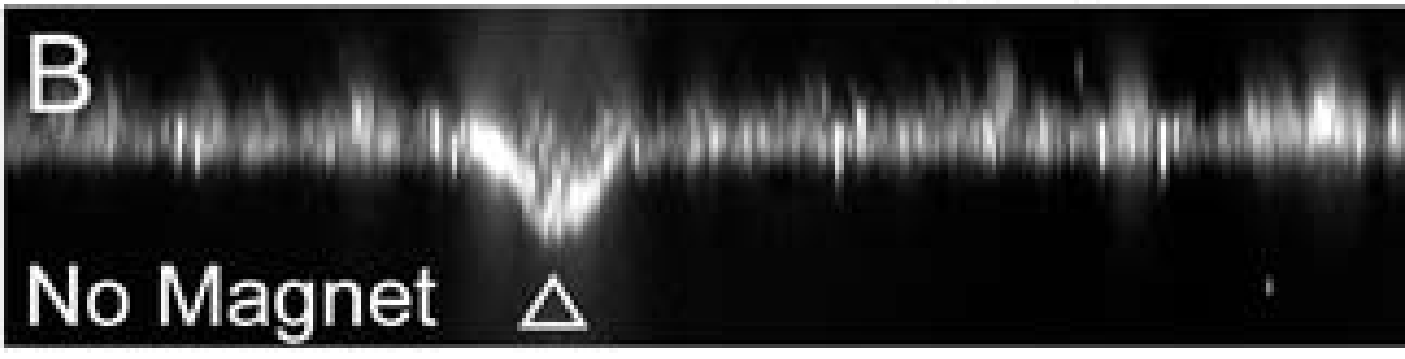
Supplementary Fig. 2: Topographical Features Exceed Lateral Displacements. Brightfield displacement map with x- and y-displacements denoted by the direction and magnitude of the arrows, and z-displacements denoted by color for samples of high (A) and low (B) surface roughness. The white shaded areas indicate regions within each image indicate where the x- and y-displacements exceed the z-displacements. Scale bar is 20 μm. (C) Comparison of the average displacement ratio for z- divided by x- (left) and y-displacements (right). A displacement ratio of 1 indicated by the line shows would signify equal planar and vertical displacement.

Supplementary Fig. 3: Topographical Features Do Not Undergo Viscoelastic Creep. (A) Initial displacement field induced by a microwire in a magnetic field. (B) Image of the displacement field after a 20 h exposure to the magnetic field. (C) Surface roughness determined over the indicated time and conditions for regions with the same microwire density. Scale bar = 20 μm.

Supplementary Fig. 4: Protein Functionalization does not change with Hydrogel Deformation. Images show a confocal cross-section through a hydrogel with and without a magnetic field present. Arrowheads indicate wire positions. Lateral and vertical scale bars are 20 and 50 μm, respectively.

Figure S1


A
Data
Linearized Fit
Force$^{1/2}$ (nN$^{1/2}$)
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
Indentation (μm)


B
No Magnet

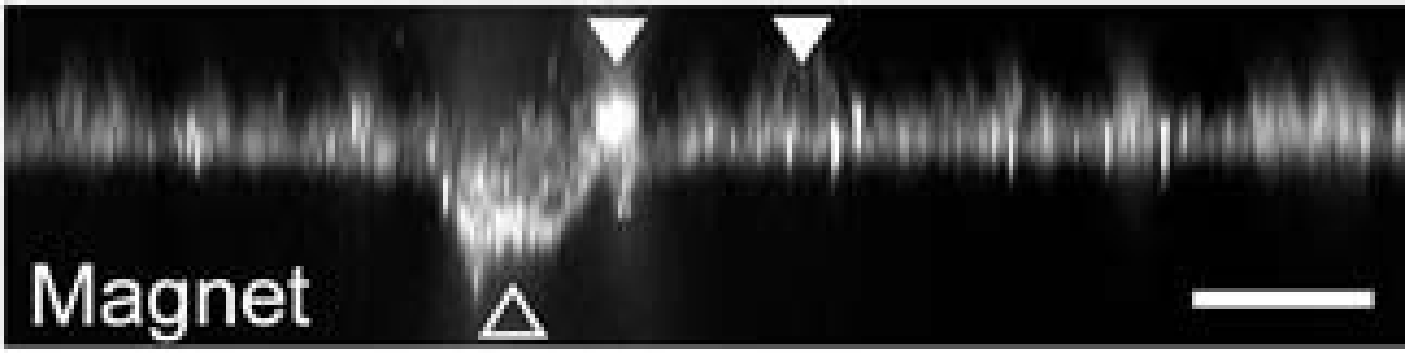
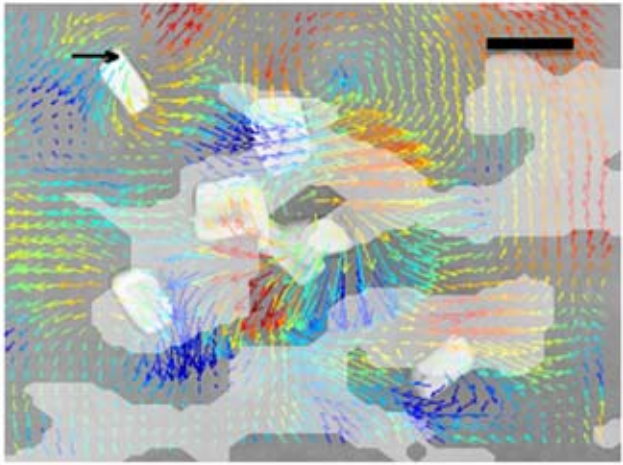
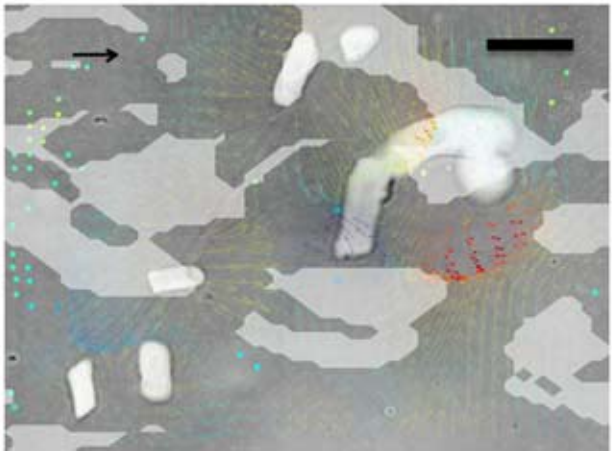

Magnet

Figure S2

A



B



C

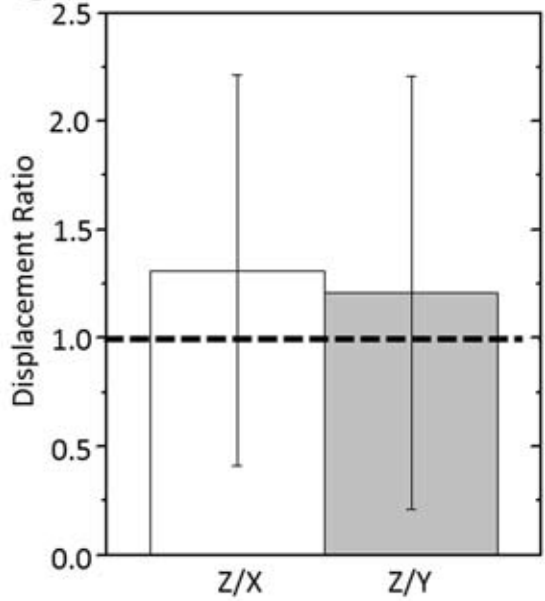
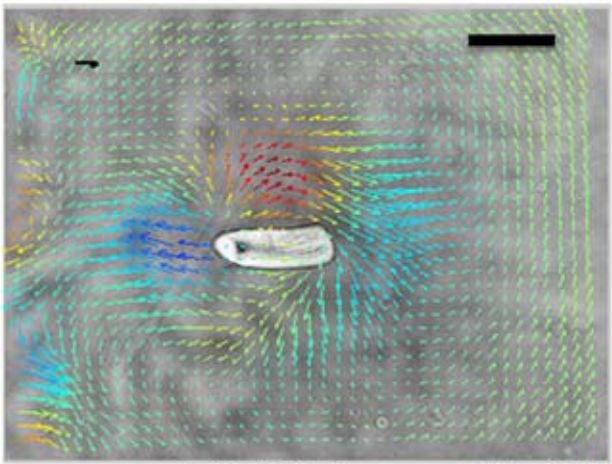


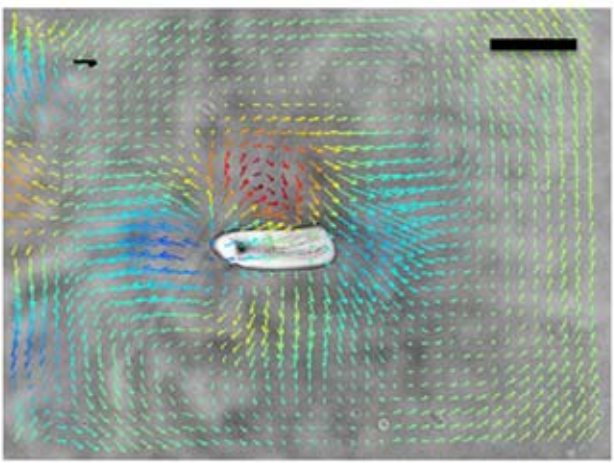
Figure S3

A



Initial Displacement (t = 0 h)

B



Final Displacement (t = 24 h)

C

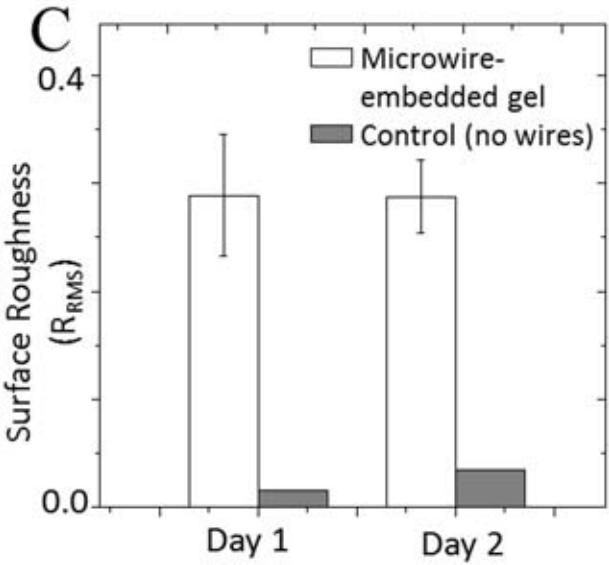


Figure S4