Controlled two-photon photodegradation of PEG hydrogels to study and manipulate subcellular interactions on soft materials

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Supporting Information:

Control MSCs

MSCs, transfected with a GFP-actin plasmid, were seeded on non-photodegradable PEG diacrylate (PEGDA) hydrogels to control for possible irradiation-induced retraction. When exposed to identical irradiation conditions as the degradable PEGdiPDA hydrogels ($E_{\text{pulse}} = 1.25 \, \text{nJ}$ and $t_c = 1.58 \, \mu s$), PEGDA gels do not undergo erosion (data not shown) and control cells seeded on the surface remain attached and spread and do not exhibit retraction over similar elapsed times (Fig. S1, Movie S3). These data suggest that, under these irradiation conditions, retraction is not induced by laser exposure, but exclusively by the selective removal of cell-material interactions.
Fig. S1 MSCs on non-photodegradable PEG hydrogels exhibit no retraction in response to light exposure. Here, we present the fractional decrease in cell area for each of the control cells studied (n = 4) and in each scenario there is no retraction observed. Instead, the cells undergo fluctuations in cell area as expected for cells actively sensing a substrate. The average maximum fractional area change (ΔA_{max}/A_0) was -0.02 ± 0.04 (mean ± s.e.m.), which is not significantly different from zero, indicating random fluctuations in cell area and not a concerted retraction mechanism.

Movie S1: A representative movie of a fast-retracting MSC on a PEGdiPDA hydrogel. The elapsed time of the video is 20 minutes post-irradiation and the green Bezier curve in the upper left represents the region that was completely eroded with two-photon irradiation. The first frame is pre-irradiation. Scale bar represents 100 μm.

Movie S2: A representative movie of a slow-retracting (top) and fast-retracting (bottom) MSC on a PEGdiPDA hydrogel. The elapsed time of the video is 60 minutes post-irradiation and the green Bezier curves in the center and lower right represent the regions that were completely eroded with two-photon irradiation. The first frame is pre-irradiation. Scale bar represents 100 μm.

Movie S3: A representative movie of a control cell on a non-photodegradable PEGDA hydrogel, which undergoes no retraction upon exposure to two-photon irradiation. The elapsed time of the video is 40 minutes post-irradiation and the green Bezier curve in the
lower right represents the region of the non-degradable PEGDA gel that was exposed to two-photon irradiation. The first frame is pre-irradiation. Scale bar represents 100 μm.