

Supporting Information  
Digital Movie Captions

**Digital Movie Files:** Digital movie file of images taken with LSCM of buffer diffusion into fluorescein-loaded  $\mu$ gels. The presence of the elevated buffer solution was signaled by an increase in the fluorescein emission, which appears as bright red under the LSCM settings. (The \*.avi files are playable with Windows Media Player on a PC, and the \*.mov files are provided for viewing with QuickTime on a Mac.)

**Control experiment with unmodified  $\mu$ gel (fig a-d.mov/ fig a-d.avi):** Upon the introduction of pH 12 buffer to the unmodified (control)  $\mu$ gel, buffer diffusion and subsequent  $\mu$ gel expansion began at the surface and uniformly moved inward until it reached the center. The diameter of the  $\mu$ gel at the start and end of the movie was 492  $\mu$ m and 950  $\mu$ m, respectively, and the actual time lapse was 37 min.

**Surfactant-induced expansion of modified  $\mu$ gel (fig e-h.mov/ fig e-h.avi):** The surfactant-induced expansion of a fatty acid-modified fluorescein-loaded  $\mu$ gel proceeded unsymmetrically, beginning in a localized area and propagating around the  $\mu$ gel's surface until the buffer diffused to the interior. The final region of the  $\mu$ gel to be exposed to the buffer solution was off center, biased towards the side furthest from initial buffer permeation. The diameter of the modified  $\mu$ gel at the start and end of the movie was 425  $\mu$ m and 958  $\mu$ m, respectively. The actual time lapse was 80 min, and the movie begins 45 min after the surfactant solution was flowed into the channel.