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Tunable liquid optics: electrowetting-controlled liquid mirrors based on self-assembled Janus tiles TOM KRUPENKIN, University of Wisconsin - Madison, MIKE BUCARO, Harvard University, PAUL KOLODNER, Bell Laboratories, ASHLEY TAYLOR, University of Wisconsin - Madison, ALEX SIDORENKO, University of the Sciences in Philadelphia, JOANNA AIZENBERG, Harvard University — In this work we describe a tunable, high-reflectivity optofluidic device based on self-assembly of anisotropically-functionalized hexagonal micromirrors (Janus tiles) on the surface of an oil droplet to create a concave liquid mirror. The liquid mirror is deposited on a patterned transparent electrode that allows the focal length and axial position to be electrically controlled. The mirror is mechanically robust and retains its integrity even at high levels of vibrational excitation of the interface. The use of reflection instead of refraction overcomes the limited available refractive-index contrast between pairs of density-matched liquids, allowing stronger focusing than is possible for a liquid lens of the same geometry. This approach is compatible with optical instruments that could provide novel functionality - for example, a dynamic 3D projector; i.e., a light source which can scan an image onto a moving, non-planar focal surface. Janus tiles with complex optical properties can be manufactured using our approach, thus potentially enabling a wide range of novel optical elements.

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