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Defining Microstructured Fluids and Soft Materials Bottom Up

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— We demonstrate a microfluidic strategy for the three-dimensional organization of soft bulk materials with a tunable microstructure. Two miscible fluid streams entered a massively-scaled microfluidic device and were distributed through an array of alternating channels. A soft lithography process was adapted to consistently define microchannels with a hydraulic diameter of 150microns in 500micron thin elastomer substrates, followed by bonding of up to ten such layers in the vertical direction. The resulting microfluidic device contained a total of one hundred microchannels. At the device exit, a complex fluid was continuously extruded as a matrix material where the pores contained the second fluid. Upon leaving the chip, the vascularized matrix was solidified and created a perfusable soft material. The material microstructure and its tunability were characterized using microscale computed tomography.

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