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Soft Plumbing: Direct-Writing and Controllable Perfusion of Tubular Soft Materials AXEL GUENTHER, PATRICIA OMORUWA, HAO-TIAN CHEN, ARIANNA MCALLISTER, MARK JERONIMO, SHASHI MALLADI, NAVID HAKIMI, University of Toronto, LI CAO, University of California, Berkeley, ARUN RAMCHANDRAN, University of Toronto — Tubular and ductular structures are abundant in tissues in a wide variety of diameters, wall thicknesses, and compositions. In spite of their relevance to engineered tissues, organs-on-chips and soft robotics, the rapid and consistent preparation of tubular structures remains a challenge. Here, we use a microfabricated printhead to direct-write biopolymeric tubes with dimensional and compositional control. A biopolymer solution is introduced to the center layer of the printhead, and the confining fluids to the top and the bottom layers. The radially flowing biopolymer solution is sandwiched between confining solutions that initiate gelation, initially assuming the shape of a funnel until emerging through a cylindrical confinement as a continuous biopolymer tube. Tubular constructs of sodium alginate and collagen I were obtained with inner diameters (0.6-2.2mm) and wall thicknesses (0.1-0.4mm) in favorable agreement with predictions of analytical models. We obtained homogeneous tubes with smooth and buckled walls and heterotypic constructs that possessed compositions that vary along the tube circumference or radius. Ductular soft materials were reversibly hosted in 3D printed fluidic devices for the perfusion at well-defined transmural pressures to explore the rich variety of dynamical features associated with collapsible tubes that include buckling, complete collapse, and self-oscillation

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