

Supporting Information for
Microsolidics: Fabrication of Three-Dimensional Metallic Microstructures in
Poly(dimethylsiloxane)

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Materials. We used the following materials and equipment: Sylgard 184 (Dow Corning), solder (AIM Solders, Inc and Small Parts, Inc, mp = 47 °C – 264 °C; see Table 1 for compositions and properties), 3-mercaptopropyltrimethoxysilane (Gelest), Micro-mate glass syringe (10 mL) wrapped in silicone heating tape (52 W, 0.5” × 2”), Digital hotplate (PMC Datamate 720), copper wires (Digikey, 200 μm diameter), photocurable polyurethane (Norland NOA81), Nanograbber™ alligator clips (Pomona), DC power supply (Agilent E3630A), infrared camera (Inframetrics, Inc.).

Injection of solder into multilayer networks of microfluidic channels: We fabricated multilayer microfluidic structures using the procedure described in the experimental section and illustrated in Figure S1. Masters for the upper and lower layers of a network of microfluidic channels were fabricated in photoresist on silicon wafers and silanized. PDMS was poured on the masters, cured thermally, and peeled away. Vias and inlet holes were punched in the lower and upper layers of channels, respectively, using needles. We aligned the top layer of channels to the lower layer of channels using a XYZ stage and plasma oxidized two layers of PDMS for 1 min; we bonded the two layers together to form a permanent seal. The two-layer device was treated with a second plasma oxidation and sealed to a third, unpatterned layer of PDMS that served as a substrate. Within 15 min of plasma oxidation, we flowed a solution of 3-mercaptopropyltrimethoxysilane in acetonitrile (0.1 M) into the network of microfluidic channels and stored the device for 1 hr. We injected metal into the multilayer microfluidic network in the same manner as for the single layer networks.

Mechanical release of solder from PDMS to produce freestanding microstructures. To release planar structures from microfluidic channels, we embossed a layer of PDMS with channels, and pressed it into conformal contact with a glass slide that had not been oxidized. The channels were silanized, filled with solder, and cooled. We released planar structures of 100% In and other solders by peeling away the PDMS layer from glass slide; the solid, metallic structures remained on the glass slide and were removed carefully from the slide using a razor blade.

Figure S1. Fabrication of metallic microstructures using multilayer lithography. The procedure describes the fabrication of a metal microstructure in a basketweave pattern; the serpentine channel represents a single “weave” in the pattern. Figure 4a shows a photograph of a completed device.

