Supporting Information

Gravity-drawn silicone filaments: production, characterization and worm-like chain dynamics

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1 Picture of uncured PDMS pouring

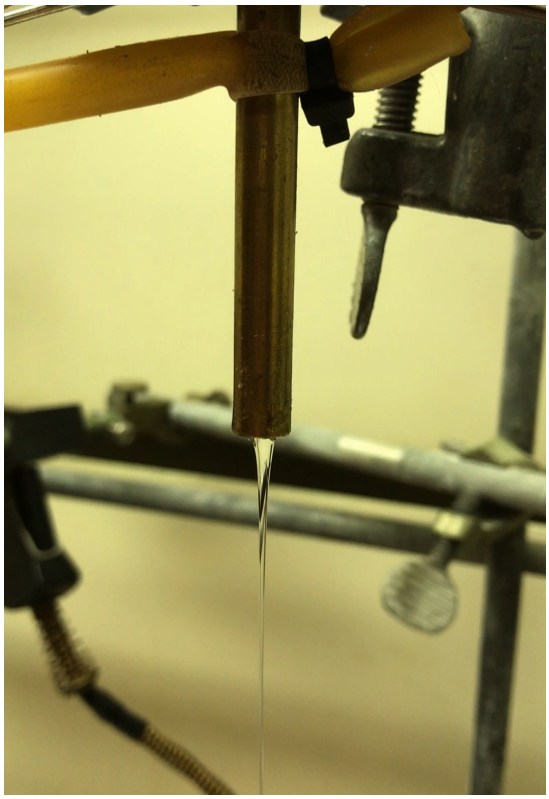

Figure S1: Uncured PDMS being extruded with a pronounced taper. This extruded PDMS was not curable with the tube oven into a filament form, in contrast to semi-cured PDMS.

2 Detailed filament production procedures

2.1 Air-cooled extrusion adapter

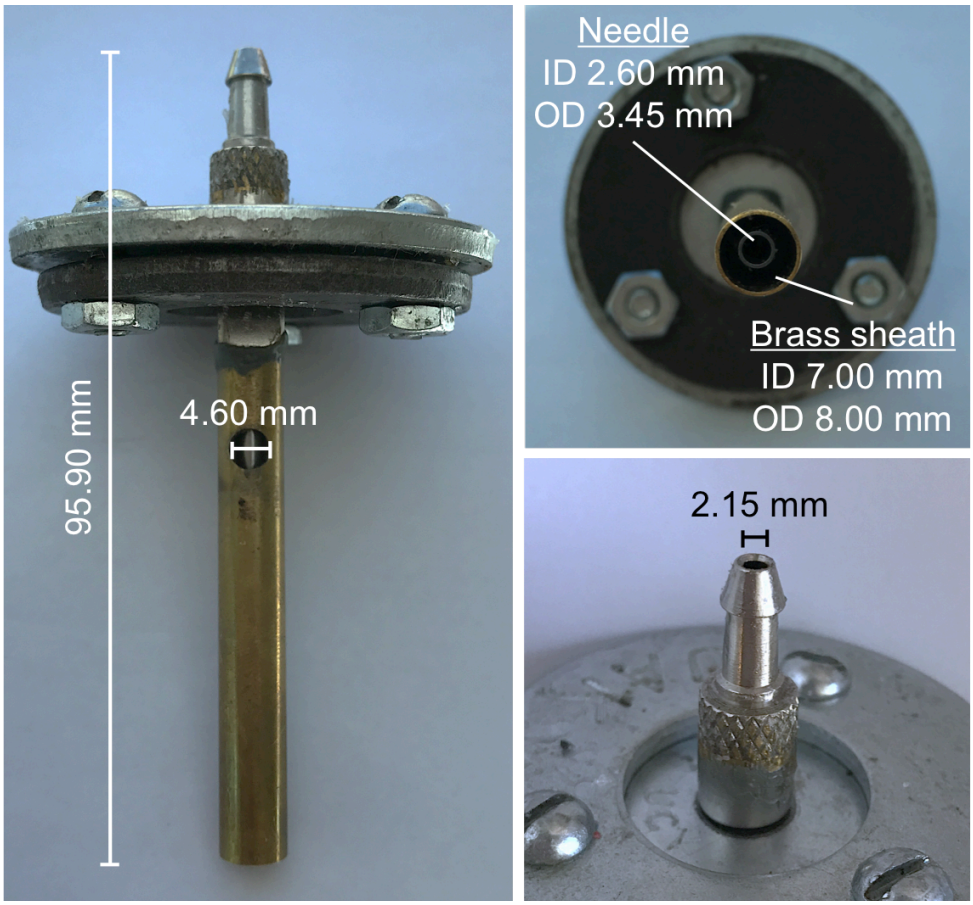

Figure S2. Needle piece without any attachments.

2.2 Filament Making Setup

Our filament making process was done in a fume hood and the setup required a tube furnace, clay extruder, needle piece and an airflow (see Fig. 3a). The hood's air flow was reduced to avoid interference with filament making, and the bottom of the hood was covered with foil to capture excess PDMS. The extrusion adapter was fastened to an aluminum ring adapter with binder clips. Latex tubing was attached to the house air supply, via a metering valve (Swagelok SS-2MA1). The hose was split on the other end and wrapped around the hole on the extrusion adapter and fastened with a zip tie (see Fig. 3b). The green extruder (Makin's Professional Ultimate Clay Extruder) was then assembled with a washer and white adapter (see Fig. 3c). High Temperature Silicone Rubber Semi-Clear Tubing (inner diameter 3.175 mm, outer diameter 6.35 mm) was attached to the white adapter with a zip tie and the other end was attached to the top of the needle piece.

Figure S3: (a) Extruder and tube furnace in the fume hood. (b) Needle piece with airflow tube attached and zip tied. (c) high temperature silicone rubber semi-clear tubing zip-tied to white adapter-cap-washer set up.

2.3 Pre-curing the PDMS

27.5g of Slygard 184 PDMS (Corning) was mixed vigorously at a 10:1 base:curing agent ratio, and placed into a vacuum desiccator to remove all bubbles. The sample was then placed into the oven at 65˚C for exactly 16 minutes for semi-curing. The temperature profile of the sample is below. While doing this, the tube furnace was turned on and heated to 250˚C.

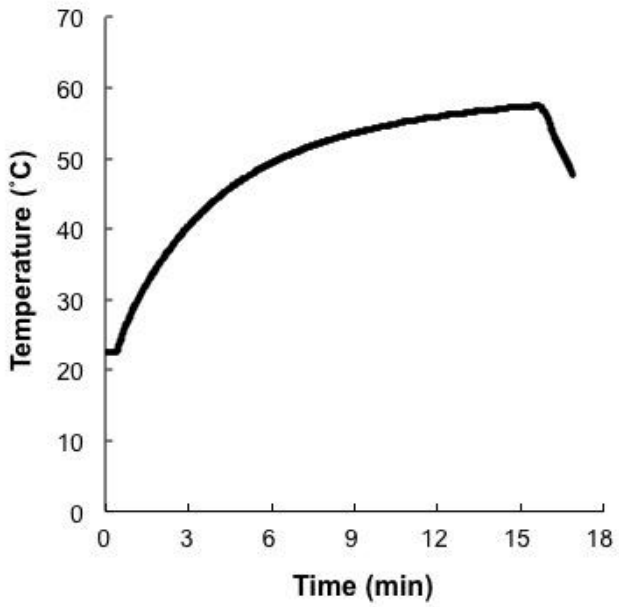

Figure S4: Temperature profile of the sample during the semi-curing process

2.4 Extruding semi-cured PDMS

The semi-cured PDMS mixture was poured into the clay extruder of the assembly above. Air flowed in order to keep the needle free of clogs and help direct the filaments straight down into the tube furnace (17.0mm inner diameter, 38.7mm outer diameter, 107.70mm length, at 250˚C). We slowly twisted the extruder to feed PDMS to the tube, and a steady stream of PDMS dripped through the furnace. We gather filaments, and re-twisted once filaments ceased exiting the aperture. Constant twisting pushed PDMS through the furnace too quickly, which did not fully cure into filaments. We caught the filaments on wooden sticks and laid them on wooden racks to finish curing.

3 Detailed description of filament agitation system

The Filament Agitation system consists of a camera suspended above a large dish (diameter 23.5 cm and depth 3 cm). The petri dish is covered in black anodized foil, filled with 200mL of water (MilliQ) with 2mMol NaCl. Above the dish rests a large ring light (Light brand/model: Neewer AC 120 V 50/60 Hz), allowing for enhanced visibility of the filament during agitation. Beneath the dish, a speaker (FileMate Joy Portable Vibration Speaker) is attached and connected to the computer in order to allow acoustic excitation of the solution and filament within. The computer plays audio (e.g., a single frequency) to the speaker and takes pictures, coordinated with Applescript software. The camera (Canon EOS 60D) is set up to either record movies or take pictures at pre-determined intervals.

Figure S5: Filament agitation system.

4 Hydrophobic patterning resolution of corona discharge

To test the resolution of the corona treater (Electrotechnic products model BD- 20AC), we cut and cleaned two strips of PDMS (25.4 mm x 50.8 mm x 1 mm) with 1% SDS by mass and rinsed with Millipore water. A line was marked in the center of each slab with a pen so the slab's center could be lined up under the electrode. One of the strips was exposed to a corona discharge at a distance of 6.35 mm for 30 seconds. Subsequently, 5–7 1µL droplets of Millipore water were placed along its edge and imaged. The other cleaned strip of PDMS was exposed to corona discharge at a distance of 3.175 mm for 30 seconds. Images were analyzed using FIJI software to measure the contact angles of these droplets. The contact angles vs. lateral spacing from the electrode were fit to a Gaussian to estimate the resolution. The 1/e point of the Gaussians were 8mm and 16mm for the 3.175mm spacing and 6.35mm spacing, respectively (Figure 5).

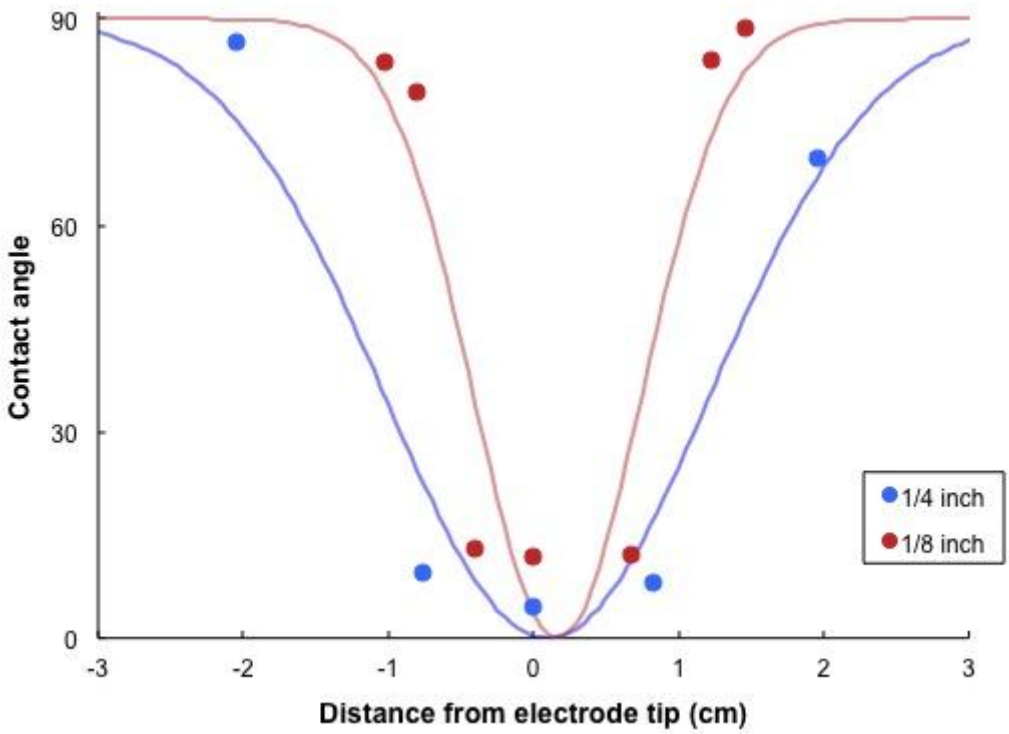

Figure S6: Contact angles measured at lateral distances from electrode tip, fit to Gaussian curves, at two different corona-surface spacings.

5 Video of filament acoustic excitation

Video is of a characteristic filament (6cm long, 75µm diameter) being acoustically agitated at 80 Hz.

6 Preliminary image of filament-filament bonding

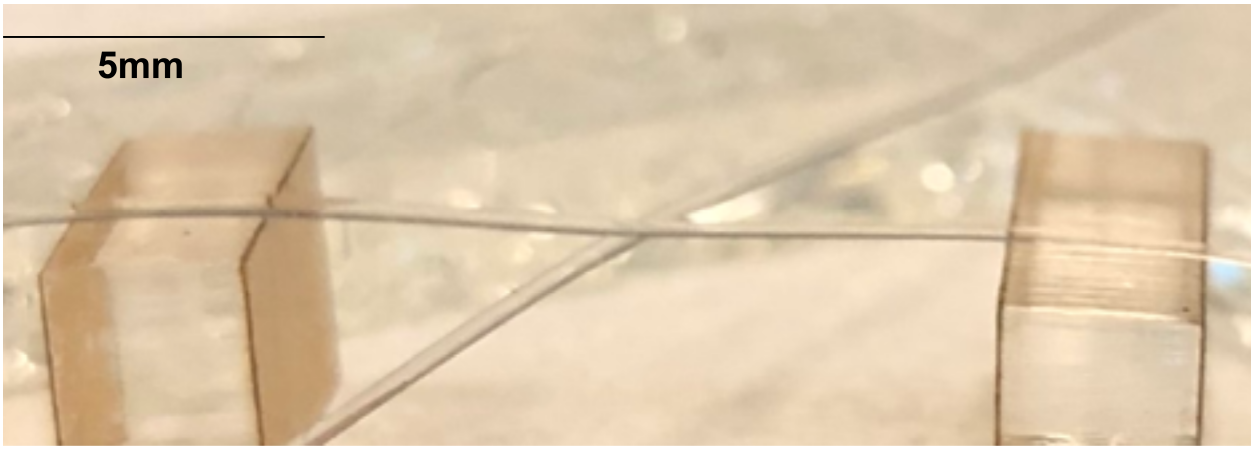

Figure S7. Two filaments were placed in contact with each other in a cross geometry and air-plasma etched for 10m. Subsequently they were placed on spacers such that the top filament was being lifted from the bottom filament. Filaments maintained adhesion, though could be pulled apart with additional force.