

## Electronic Supplementary Information (ESI)

### Transient bioelectrical devices inspired by a silkworm moth breaking out of its cocoon

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#### Equipment

Heating mantle with a temperature controller (Shanghai Songdao Heating Sensor Co., Ltd.), an ultrasonic cleaning bath (KQ-100DA, Kunshan Ultrasonic Instrument Co., Ltd.), centrifuge (H1850, Hunan Xiang Yi Laboratory Instrument Development Co., Ltd), digital source meter (2450 SourceMeter, Keithley), regulated DC power supply (UTP3325TFL, UNI-T), syringe pump (LSP02-1B, Longer Precision Pump Co., Ltd.), oven (DHP-9012, Shanghai-Heng Science Instrument Co., Ltd.), drawing machine (P-1000, Sutter Instrument), laboratory balance (BSA224S, Sartorius), infrared imager (E50, FLIR), heating station (RET basic, IKA), smooth rubber spin coater (H6-23, Laurell), fluorescence polarization microscope (DM600BDM, Leica), vapor deposition instrument (GSL-1800X-ZF4, Shenyang Kejing Automation Equipment Co., Ltd.), and magnetron sputtering device (MP-620, Beijing Jinsheng Micro Technology Co., Ltd.)

#### Fabrication of the capillary with a needle tip

A drawing machine was utilized for the preparation of capillaries with needle tips (**Fig. S1**). First, the glass capillary was fixed on the platform to measure the melting point. Second, the heating temperature was set near the melting point (543°C), and the tensile parameters were obtained. Third, the capillary was pulled to obtain a capillary with a needle tip. Finally, the size of the needle tip was refined by cutting the tip with a needle breaker (**Fig. S2**).

#### Synthesis of silver nanowires

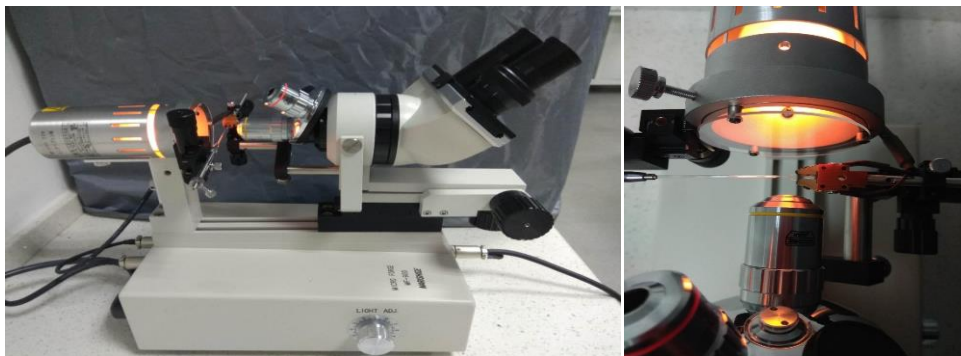
First, 0.26 g polyvinylpyrrolidone, 0.8 mg copper nitrate trihydrate, and 80 mL ethylene glycol were placed in a 250 mL three-necked flask and stirred for 5 min. Then, the mixture was heated to 180°C and stirred at this temperature for 30 min. Next, the three-necked bottle was closed, placed in a desiccator and allowed to naturally cool. To the above cooled solution, 0.24 g of silver nitrate was

added, and the mixture was vigorously stirred for 10 min until the silver nitrate was completely dissolved and particles were not visible to the naked eye. The stirring ceased, and the mixture was heated at 145°C for 7 h.

After the reaction, a large amount of suspended matter was present on the surface of the reaction system, and the reactant was washed with ethanol and acetone and centrifuged at 1000-3000 rpm 3-5 times, and the bottom precipitate was dispersed in ethanol for use.

#### **Control of shell thickness and size of the microspheres**

By improving the flow rate of the inner or outer phase, the amount of the product increased and the shell thickness and size of the microspheres decreased (**Fig. S9**).



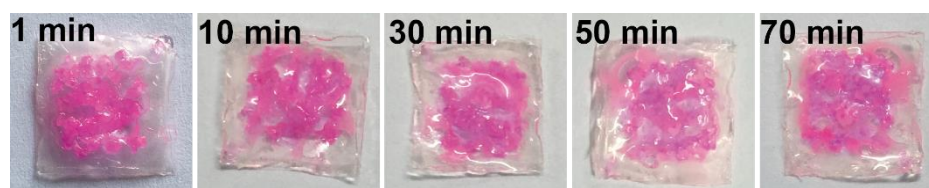
**Fig. S1** Pulling the capillary by a needle puller.



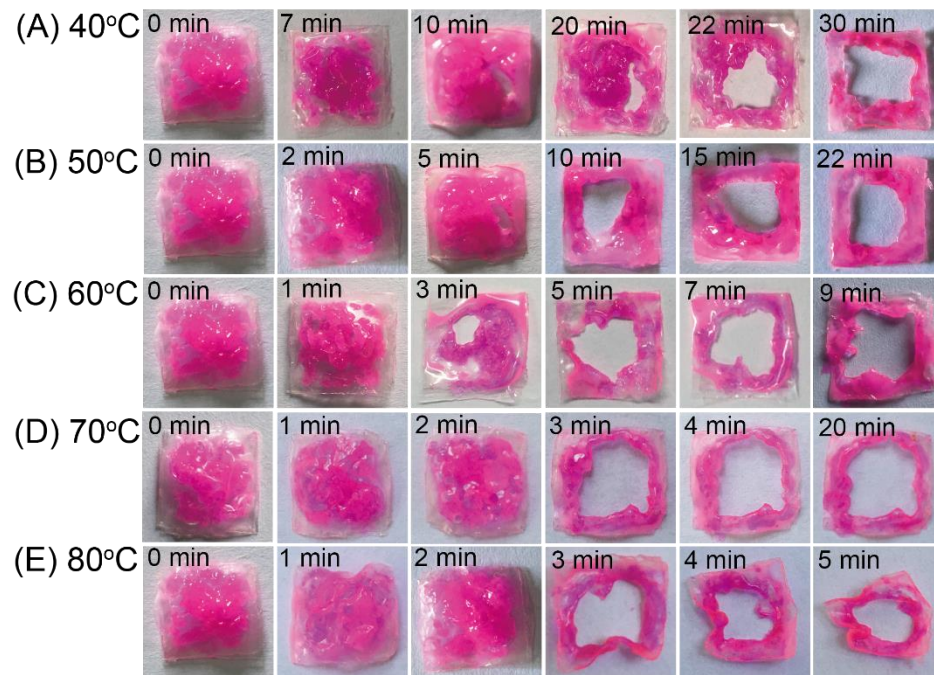
**Fig. S2** Micropipette puller



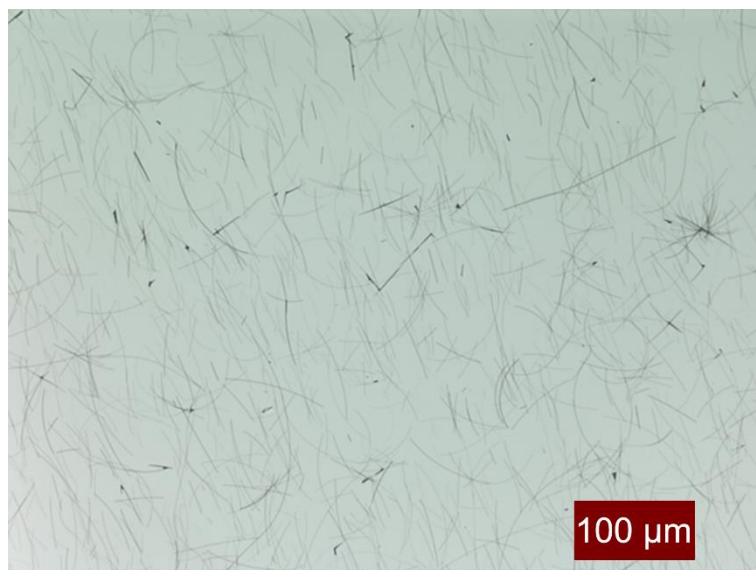
**Fig. S3** Scheme of the microfluidic capillary



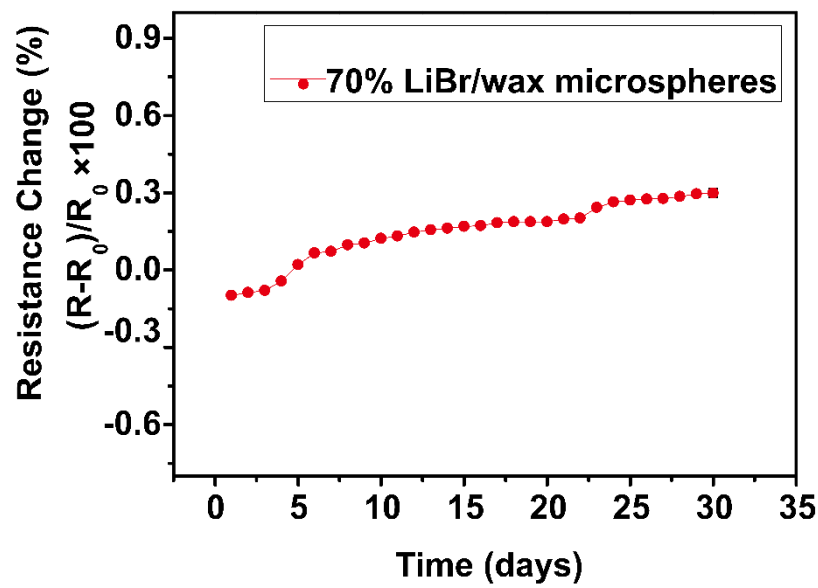
**Fig. S4** The dissolution process of a silk film with 40 wt.% microsphere content at 60°C.



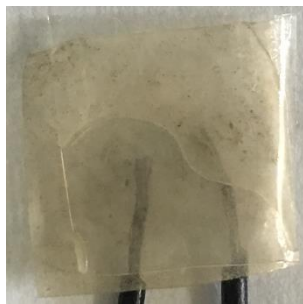
**Fig. S5** Silk film dissolution with 70 wt.% microsphere content at different times and heated at 40°C, 50°C, 60°C, 70°C, and 80°C.



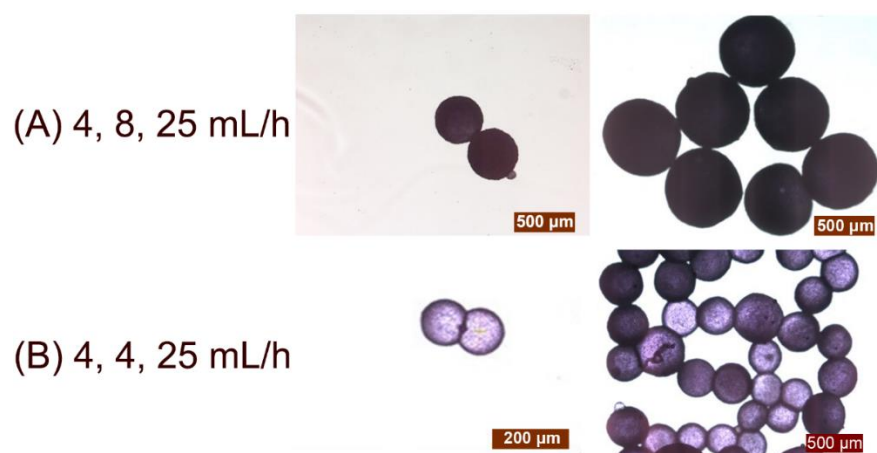
**Fig. S6** Micrograph of silver nanowires coated on a silk film by a fluorescence polarizing microscope.



**Fig. S7** The silk films coated with a mass fraction of 70% LiBr/wax microspheres showed a highly stable response (negligible resistance change) for one month at room temperature.



**Fig. S8** The SF device with a middle layer of pure wax under the same bias voltage of 2 V; the SF film does not degrade.



**Fig. S9** Reduce shell thickness and reduce microsphere size by reducing the flow rate of the middle phase. (A) the flow rate of the inner , middle , and outer phase 4, 8, 25 mL/h. (B) the flow rate of the inner, middle, and outer phase 4, 4, 25 mL/h.