Trapping Self-Propelled Micromotors with Microfabricated Chevron and Heart-Shaped Chips

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Supporting Information

Micromotor fabrication

For the performance of all the experiments presented here, our catalytic micromotors were produced using rolled-up technology on polymers as previously reported.[19] The thin films are composed of Ti (3 nm), Fe (3 nm), Cr (3 nm) and Pt (3 nm). Once rolled, the final micromotor dimensions were 50 μm in length and 3.75 μm in diameter.

Microfluidic chips fabrication

All the microfluidic chips were created via replica moulding using a silicon master fabricated via plasma etching. For this process, a photomask was designed and the patterns were transferred by photolithography to a 4-inch silicon wafer (<100> orientation) previously coated with a photoresist by spin coating at 3500 rpm for 35 s. After the development, a 10 nm layer of chromium was deposited on the patterned samples using e-beam evaporation in a flat angle. Afterwards, the samples were placed in acetone in an ultrasonic bath to lift off the areas covered with the photoresist leaving chromium solely on those regions where no photoresist was initially present. The patterned silicon substrates were placed in a plasma chamber in which sulphur hexafluoride (SF_6) was used to etch the silicon at a pressure of 0.24 mbar, a flow rate of 3 sccm and a power of 225 watts. The areas coated by chromium were protected from the etching and remained. The approximate etching rate was 0.5-0.6 μm/min. The depth of the structure was measured using a Dektak profilometer system.

The polydimethylsiloxane (PDMS)-based microfluidic device was prepared using the Sylgard 184 Silicone Elastomer KIT (Dow Corning, MI, USA). First, the polymer and the crosslinking agent were hand-mixed in a 10:1 ratio and degassed in a vacuum chamber for 30 minutes. Then, the PDMS mixture was slowly poured into a petri dish containing the silicon masters previously fabricated and cured at 100º for 15-20 minutes. The chips were finally cut, peeled and placed in microscope glass slides to facilitate their handling. Before each experiment, the chips were treated with oxygen plasma to make the surface hydrophilic (1 minute, 80 watt and an O_2 flux of 5 sccm).

Experimental set-up

For each experiment, micromotors were placed in the microfluidic chips together with a solution containing a final concentration of 3% H_2O_2 and 1% Sodium dodecyl sulfate (SDS). Videos were recorded using the Zeiss Axiotech microscope in bright field mode and the high-speed camera Axiocam HSm.