Supporting Information

Thermal activation of catalytic microjets in blood samples using microfluidic chips

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Supporting Videos

SI Video 1. Motion of microjets at room temperature (25°C) in 1 mL PBS solution containing 3 wt. % H_2O_2 and 1 wt.% SDS, first temperature cycle.

SI Video 2. Motion of microjets at physiological temperature (37°C) in 1 mL PBS solution containing 3 wt. % H_2O_2 and 1 wt.% SDS, first temperature cycle.

SI Video 3. Motion of microjets at room temperature (25°C) in suspensions of red blood cells x10 times diluted (5 x 10^5 RBC μL^{-1}) containing 3 wt. % H_2O_2 and 1 wt.% SDS in PBS in a total volume of 1mL. Third temperature cycle.

SI Video 4. Motion of microjets at physiological temperature (37°C) in suspensions of red blood cells x10 times diluted (5 x 10^5 RBC μL^{-1}) containing 3 wt. % H_2O_2 and 1 wt.% SDS in PBS in a total volume of 1mL. Third temperature cycle.

SI Video 5. Motion of microjets at physiological temperature (37°C) in suspensions of red blood cells x10 times diluted (5 x 10^5 RBC μL^{-1}) and 10 wt.% serum containing 3 wt. % H_2O_2 and 1 wt.% SDS in PBS in a total volume of 1mL. Third temperature cycle.

SI Video 6. A microjet engine moving against flow in a microfluidic channel at physiological temperature (37°C) in suspensions of red blood cells x10 times diluted (5 x 10^5 RBC μL^{-1}) and 10 wt.% serum containing 3 wt. % H_2O_2 and 1 wt.% SDS in PBS.

Experimental methods

Fabrication of microjets: Photoresist AR-P 3510 was spin-coated on glass covers (22x22mm^2) at 3500 rpm for 35 s, followed by a soft bake using a hotplate at 90 °C for 3 min and 7 sec exposure to UV light (365 nm) with a Karl Suss MA-56 Mask Aligner. Photoresist patterns were then developed in an AR300-35:H_2O solution (1:1). The Fe thin membranes were deposited by

electron-beam evaporation (e-beam, Edwards Thin Film Systems), whereas the Pt layers were deposited by magnetron sputtering (MTD 450 DCA instruments). After deposition of the metals, the samples were immersed in dimethilsulfoxide:acetone (1:1) that selectively under-etches the photoresist layer and consequently the rolling-up of the thin metallic films into microtubes takes place.

Materials. Hydrogen peroxide (H_2O_2, 31 wt%) was purchased from BASF-The Chemical Company. Sodium dodecyl sulfate (99%), human serum (from human male AB plasma) and red blood cells (lyophilized, glutaraldehyde stabilized, from sheep) were purchased from Sigma-Aldrich. Dulbecco's Phosphate buffer saline (PBS x1, pH 7.2) was from Gibco. All solutions were daily prepared.

Equipment: A Zeiss Axio Microscope featuring a high speed camera was used to record videos of actively moving tubes in solution at a rate of 60 frames per second. The free software FiJi (National Institutes of Health, USA) was used to track speed of micromotors and to edit videos and pictures. The temperature was controlled by a Peltier element, coupled to a DC power supply (Hameg Instruments), which was placed underneath the sample containing the microjets suspension in blood components, surfactant, H_2O_2 and PBS. Cooling of the system was carried out by applying a suitable current whereas, reversing the bias resulted in the heating up of the Peltier element; every 0.1 A increment of the applied current resulted into 3 °C change in the temperature of 1 mL of solution. The Peltier element used in this work (40 x 40 x 4 mm, length x width x height) can develop a maximum power of 41 W and a current of 4.6 A, with a nominal voltage up to 15.4 V. The temperature was monitored using a digital thermometer immersed into the solution containing the microjets.

Supporting figures

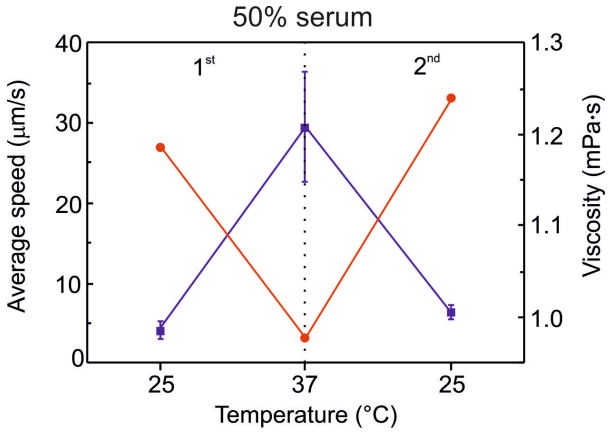

Figure S1: Temperature cycles applied to a sample containing 50% serum and microjets, evolution of the average speed of microjets warming up the solution from 25°C to 37°C and cooling down to 25°C and their corresponding viscosity measured values. (50 wt.% serum containing 3 wt. % H_2O_2 and 1 wt.% SDS in PBS in a total volume of 1mL)