Supporting Information

Visible-light Controlled Catalytic Cu_2O-Au Micromotors

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Supporting Videos

Video S-1. One Cu_2O-Au micromotor moving towards Au side in 2.5% H_2O_2.
Video S-2. Brownian motion of a Cu_2O micromotor under visible light in 2.5% H_2O_2.
Video S-3. Motion of a Cu_2O-Au micromotor under visible light in 2.5% H_2O_2 with 5mM $NaNO_3$.
Video S-4. Visible light triggered "Stop and Go" of a Cu_2O-Au micromotor in 2.5% H_2O_2.

Supporting Figures

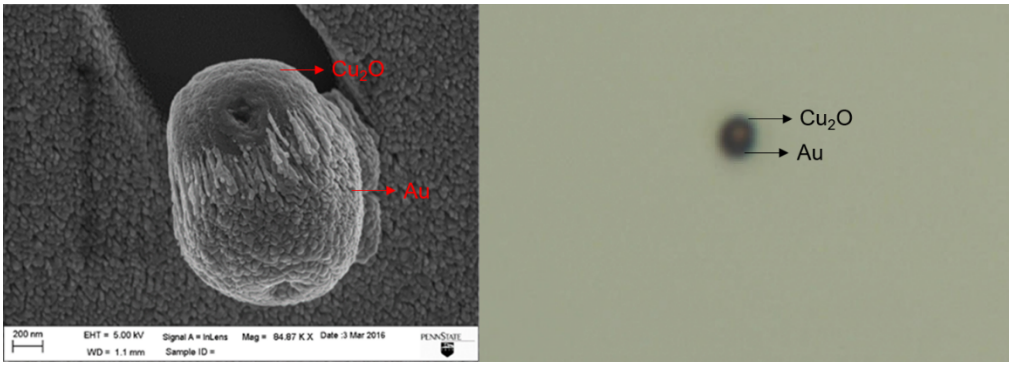

Fig S1. Au-Cu_2O micromotor with 200 nm Au sputtered onto a Cu_2O sphere. For typical Au-Cu_2O micromotors, 30 nm of Au was coated onto the Cu_2O microparticles. The shadowing of the particle in the angled Au deposition is evident in the SEM image.

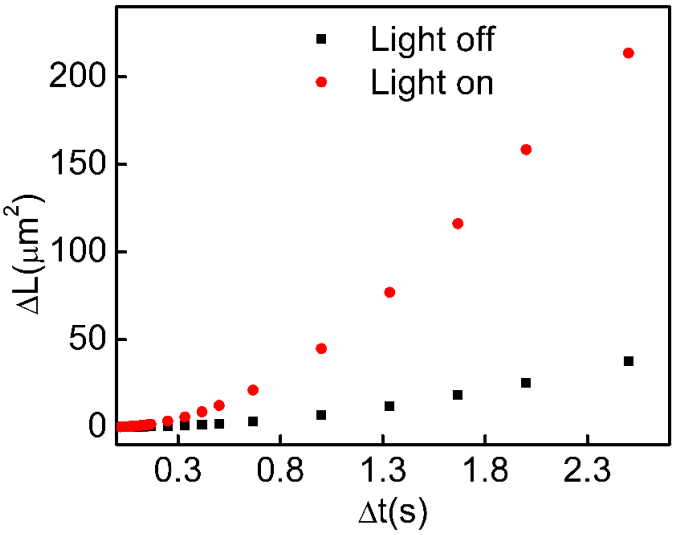

Fig S2. MSD of Au-Cu_2O micromotors with and without illumination (see Video S-4).

Experimental

Micromotor Synthesis and Characterizations

Cu_2O microspheres were prepared based on a previously reported method.[36] In a typical synthesis, 1 g of copper acetate (ACS Reagent, >98%) was dissolved in 40 mL of deionized water (18.2 MΩ-cm) and mixed with 40 mL of absolute ethanol at 70 °C with stirring. Then, 1.4 g of sodium hydroxide (ACS Reagent, >97%) and 1.2 g of glucose (Sigma, 99.5%) were added to the solution; the solution was heated for another 30 min at 70 °C and then allowed to cool to room temperature. The precipitate was collected by centrifugation at 3000 rpm for 5 min and washed with deionized water and ethanol three times each. The precipitate was collected and then further dried in vacuum for 1 h. 0.1 g of the Cu_2O microspheres was re-dispersed in 1 mL ethanol and drop-cast onto a glass slide to form a monolayer of Cu_2O spheres. The spheres were subsequently coated with 30 nm of gold by using a Kurt J Lesker Lab-18 E-gun thermal evaporator. The final Cu_2O-Au micromotors were sonicated and collected in water for motility experiments.

Materials characterization

The morphology and elemental composition of the Cu_2O particles and the Cu_2O-Au micromotors were characterized by FEI NanoSEM 630 scanning electron microscopy and energy dispersive X-ray spectroscopy. X-ray powder diffraction patterns of the Cu_2O particles were recorded on a PANalytical XPert Pro diffractometer. UV-vis diffuse-reflectance spectra of the Cu_2O samples on glass slides were measured by using a Perkin-Elmer Lambda 950 spectrometer.

Optical Imaging and Tracking

The motion of the the Cu_2O-Au micromotors was tracked by using video spot tracker V08.11 software. Motors were tracked for 30 s and mean square displacements (MSD) were calculated at different light intensities and H_2O_2 concentrations. All speeds were calculated by averaging the instantaneous speeds of 30 different micromotors.

Electrochemical Experiments

Tafel experiments were measured in a two-electrode configuration with either a Cu_2O electrode or Au electrode against an Ag/AgCl reference electrode under light and dark conditions. The Cu_2O electrode was made by drop casting Cu_2O particles on a FTO glass; the Au electrode was made by Au vacuum deposition onto FTO glass (Q150R Rotary-Pumped Sputter Coater). An Ag/AgCl electrode was used as both counter and reference electrode in the Tafel experiments since only small an amount of current was passed. 2.5 v% H_2O_2 solution were used as the electrolyte without any other supporting electrolyte, similar to the optical testing conditions. Light chopping experiments were done with a solid junction Cu_2O-Au electrode. Typically, Cu_2O was electrochemically deposited onto FTO glass according to reported procedures.41 A 30 nm film of Au was then sputter deposited onto the Cu_2O layer in a procedure similar to the micromotor particle synthesis. The open circuit voltage was measured with potentiostat connecting to the solid junction

electrode by the Au surface and the substrate FTO surface. J-V curves were measured in a similar solid junction setup at a scan rate of 20 mV/s. A 100 mW/cm2 Xe lamp and NuVant EZStat potentiostat were used in all the electrochemical experiments.