Active micromotors: efficient Marangoni-driven microgears and self-assembling Janus micromachines

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In the first part of the talk I will present a new type of light-activated motors with unprecedented efficiency[1](Fig.(a), (b)). These consist in asymmetric microfabricated gears covered by an absorbing coating that converts the energy of wide-field illumination into rotational motion. These micromotors are suspended at an air-liquid interface and produce a non-homogenous heating of the fluid that, in turn, causes a surface tension-driven torque spinning the rotor up to 300 rmp. It is shown that these microdevices have an efficiency orders of magnitude higher than rotors relying on direct optical momentum transfer or on thermophoresis. In the second part of the talk I will show how we were able to design self-assembling micromotors from catalytic (Janus) self-propelling particles and passive microgears[2](Fig.(c)). This combination leads to the fully autonomous construction and propulsion of rotors via the almost perfect alignment of Janus particles with the gear’s edge. It will be discussed how the performances of these motors are affected by hydrodynamics and competition for fuel.

Figure (a) Microscopy picture of a light-activated micromotor spinning at the air-liquid interface. (b) The inhomogenous temperature profile generated unbalances surface tension (arrows) and drives the rotation of the gear. (c) Self-assembled micromotor composed by a passive rotor and Janus particles that are randomly distributed before addition of hydrogen-peroxide, coloured area is the angle spanned in 4 s.
