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Highly-Controllable Near-Surface Swimming of Magnetic Nanorods BENJAMIN EVANS, Elon University, LAMAR MAIR, UNC - Chapel Hill — Directed manipulation of nanomaterials has significant implications in the field of nanorobotics, nanobiotechnology, microfluidics, and directed micro- and nano-object assembly. With this in mind, we present a simple, efficient method for the fabrication and controlled manipulation of rod-shaped micro-scaled swimmers in a low-Reynolds environment. We demonstrate fine spatial control of the swimmers' motion and we approach, capture, and manipulate a polystyrene microbead as proof of principle. The swimmers consist of 200-nm-diameter gold nanowires which are grown by electrodeposition in an AAO template. The template is removed via dissolution in NaOH, and a layer of nickel (50 nm) is subsequently evaporated onto the surface of the wires. These wires settle near the floor of an enclosed water-filled cell and are observed via optical microscopy. Rotation is induced via an external magnetic field provided by a permanent magnet. The field is rotated in a plane nearly parallel to the floor; a small tilt out-of-plane results in symmetry-breaking, with the end of the rod nearest the floor experiencing an enhanced drag coefficient due to the presence of the boundary. The imbalance in drag forces between the two ends of the rotating rod results in a net translation. We use resistive force theory to develop an analytical model which describes the motion of these swimmers and correlate this model with experimental results.

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