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Magnetically Driven Swimming of Nanoscale Colloidal Assemblies JENNIFER BREIDENICH, JASON BENKOSKI, LANCE BAIRD, RYAN DEACON, H. BRUCE LAND, ALLEN HAYES, Milton S. Eisenhower Research Center, The Johns Hopkins University Applied Physics Laboratory, Laurel MD 20723, PEI KENG, JEFFREY PYUN, Department of Chemistry, University of Arizona, Tucson AZ 85721 — At microscopic length scales, locomotion can only be generated through asymmetric conformation changes, such as the undulating flagellum employed by protozoa. This simple yet elegant design is optimized according to the dueling needs of miniaturization and the fluid dynamics of the low Reynolds number environment. In this study, we fabricate nanoscale colloidal assemblies that mimic the head + tail structure of flagellates. The assemblies consist of two types of magnetic colloids: 25 nm polystyrene-coated Co nanoparticles, and 250 nm polyethylene glycol coated magnetite nanoparticles. When mixed together in N-dimethylformamide, the Co nanoparticles assemble into flexible, segmented chains ranging in length from 1 - 5 μm. These chains then attach at one end to the larger magnetic beads due to magnetic attraction. This head + tail structure aligns with an external uniform magnetic field and is actuated by an oscillating transverse field. We examine the effects of Co nanoparticle concentration, magnetite bead concentration, magnetic field strength, and oscillation frequency on the formation of swimmers and the speed of locomotion.

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