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Nanoscale Assembly of Actuating Cilia-Mimetic[1] LANCE BAIRD, JENNIFER BREIDENICH, BRUCE LAND, ALLEN HAYES, JASON BENKOSKI, Johns Hopkins University Applied Physics Laboratory, PEI KENG, JEFFREY PYUN, University of Arizona — The cilium is among the smallest mechanical actuators found in nature. We have taken inspiration from this design to create magnetic nanochains, measuring approximately 1-5 μm long and 25 nm in diameter. Fabricated from the self-assembly of cobalt nanoparticles, these flexible filaments actuate in an oscillating magnetic field. The cobalt nanoparticles were functionalized with a polystyrene/benzaldehyde surface coating, thus allowing the particles to form imine bonds with one another in the presence of a diamine terminated polyethylene glycol. These imine bonds effectively cross-linked the particles and held the nanochains together in the absence of a magnetic field. Using design of experiments (DOE) to efficiently screen the effects of cobalt nanoparticle concentration, crosslinker concentration, and surface chemistry, we determined that the morphology of the final structures could be explained primarily by physical interactions (i.e. magnetic forces) rather than chemistry.

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