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Nature-inspired polymer actuators for micro-fluidic mixing. JAAP M.J. DEN TOONDER¹, Eindhoven University of Technology, FEMKE BOS, JUDITH DE GOEDE, Philips Research, PATRICK ANDERSON, Eindhoven University of Technology — One particular micro-fluidics manipulation mechanism "designed" by nature is that due to a covering of beating cilia over the external surface of micro-organisms (e.g. Paramecium). A cilium can be viewed as a small hair or flexible rod (in protozoa: typical length 10 microns and diameter 0.1 microns) which is attached to the surface. We have developed polymer micro-actuators, made with standard micro-technology processing, which respond to an applied electrical or magnetic field by changing their shape. The shape and size of the polymer actuators mimics that of cilia occurring in nature. Flow visualization experiments show that the cilia can generate substantial fluid velocities, in the order of 1 mm/s. In addition, using specially designed geometrical configurations of the cilia, very efficient mixing is obtained. Since the artificial cilia can be actively controlled using electrical signals, they have exciting applications in micro-fluidic devices.

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