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Nature-inspired micro-fluidic manipulation using artificial cilia
JAAP DEN TOONDER, Philips Research and Eindhoven University of Technology, JUDITH DE GOEDE, Philips Research, VINAYAK KHATAVKAR, 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 μm and diameter 0.1 μm) 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. We have shown experimentally that, indeed, our artificial cilia can induce significant flow velocities of at least 75 μm/s in a fluid with a viscosity of 10 mPas. In this paper we will give an overview of our activities in developing the polymer actuators and the corresponding technology, show experimental and numerical fluid flow results, and finally assess the feasibility of applying this new and attractive micro-fluidic actuation method in functional biosensors.

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