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The Motion of Ultrasonically Propelled Nanomotors Operating in Biomimetic Environments

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Abstract : Nanomotors, also commonly referred to as nanorobotics or nanomachines, have garnered considerable research attention due to their numerous potential applications in biomedicine, including drug delivery and microsurgery. Nanomotors typically consist of inorganic or polymeric particles that are powered to undergo motion. These artificial, man-made nanoscale motors operate in the low Reynolds number regime and typically have no moving parts. Several methods have been developed to actuate the motion of nanomotors including magnetic fields, electrical fields, electromagnetic waves, and chemical fuel. Since their introduction in 2012, ultrasonically powered nanomotors have been explored in biocompatible fluids and even within living cells. Due to the common use of ultrasound within the biomedical community for both imaging and therapeutics, the introduction of ultrasonically propelled nanomotors holds significant potential for biomedical applications. In this work, metallic nanomotors are electrochemically plated within porous anodic alumina templates to have a diameter of 300 nm and a length that is 2-4 µm. Nanomotors are placed within an acoustic chamber capable of producing bulk acoustic waves in the ultrasonic range. The motion of nanomotors within biomimetic confines is explored. The control over nanomotor motion is exerted by virtue of the properties of the acoustic signal within these biomimetic confines to control speed, modes of motion and directionality of motion. To expand the range of control over nanorod motion within biomimetic confines, external forces from biocompatible magnetic fields, are exerted onto the acoustically propelled nanomotors.

Keywords : nanomotors, nanomachines, nanorobots, ultrasound
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