Magnetically-Powered Multi-Segment Degradable Microswimmer

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Microswimmers are microscopic-scale machines that are designed to perform and undergo specific movement in response to external stimuli. In this project, a magnetically-powered multi-segment degradable microswimmer that can move in fluids was invented. It consists of four rigid segments, including a head and three rigid body parts, each connected by a soft spring. Its overall size is 200 micron in length and 8 micron in diameter. The microswimmer is made from degradable composite materials and can be fabricated integrally by 3D laser lithography utilizing two-photon polymerization principle. In-vitro and ex-vivo experiments were conducted to demonstrate that the microswimmer, under an external oscillating magnetic field, can undergo non-reciprocal motion and achieve undulatory locomotion in a low Reynolds number environment, with the swimming direction precise and well-controlled. Experiments show that the microswimmer can be successfully degraded in in-vitro and in-vivo environments, demonstrating it can be safely applied in living organisms. Structural integrity tests have also been performed, demonstrating that the microswimmer maintains strong structural integrity. This microswimmer possesses advantages to previous designs in the form of a simple structure allowing for low-cost mass production, increased structural integrity, improved propulsion ability, and enhanced degradability allowing for safe use in in-vivo environments. This microswimmer can potentially be used for precision medical therapies such as target delivery, diagnosis and micro-surgery.

Awards Won:

Second Award of $2,000

International Council on Systems Engineering - INCOSE: Second Award of $500