Acoustically Triggered Nano/Microscale Propulsion Devices

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Technology description

University researchers have developed new nano/microscale propulsion devices (NMSPD) that utilize ultrasound to externally trigger on-board fuel (i.e., perfluorocarbon emulsions), bound within the device interior, for ultrafast NMSPD propulsion. The invention includes methods of fabricating the NMSPD devices. The NMSPDs are biocompatible and accelerate quickly, reaching high average velocities (> 6 m/s) that are more than 100 times faster than conventional micromachines. The high thrust of the devices enables piercing, puncturing, deep penetration, deformation, and tearing apart of tissue (e.g.when fired into lamb kidney sections). Firing can also be oriented magnetically and multiple NMSPDs can be fired simultaneously. The core technology is scalable and flexible in terms of shape, design, materials used, fabrication process and external triggering source.

Micro/nanoscale motor designs typically require conversion of external chemical energy in the vicinity of the rockets to promote autonomous propulsion. Several mechanisms have been developed to realize such rocket thrust in connection with hydrogen-peroxide fuel, including self-electrophoresis and bubble propulsion. Fuel-free microrocket propulsion mechanisms that are more biocompatible have also been explored, including the utilization of electrical power (i.e., diode nanowires) and magnetic oscillation. While these microscale propulsion mechanisms have inherent advantages, they lack the thrust needed for penetrating tissue barriers and cellular membranes.

Related Materials

"Acoustic Droplet Vaporization and Propulsion of Perfluorocarbon-Loaded Microbullets for Targeted Tissue Penetration and Deformation", Angew. Chemie Int. Ed., 51 (2012) 7637.

"Healing Bullets Fly Through Tissue", Chemistry Views, June 2012

Application area

Applications of the invention includein vivodrug delivery, artery cleaning, biomolecular/cellular delivery, tissue sampling, crossing the blood/brain barrier, tissue penetration for triggering immune responses and/or targeted gene regulation schemes.

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