Active Oral Drug Delivery Micromotor-based Systems

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Abstract

Tremendous progress has been achieved during the last decade towards the design of micromotors with high biocompatibility, multifunctionality, and efficient propulsion in biological fluids, which collectively have led to the initial investigation of in vivo biomedical applications of these synthetic motors. Six decades after Richard Feynman's visionary lecture, we are currently witnessing the creation and application of robotic pills that merge the distinct strengths of microrobotic and oral delivery technologies.

In this lecture, new developments towards the realization of clinical translation of this technology are reported. Firstly, by integrating synthetic micromotors with pharmaceutical pills for active and enhanced oral delivery applications. In vivo studies using a mouse animal model show that the micromotor pill platform effectively protects and carries the active micromotors to the stomach, enabling their release in a concentrated manner [1] [2].

Secondly, by utilizing Mg-based micromotors as microstirrers, due to their self-stirring built-in capabilities, to fabricate microstirring pills towards enhanced fluid dynamics of payloads and improved drug bioavailability. In vivo studies using murine and porcine models demonstrate that the localized stirring capability of microstirrers leads to enhanced bioavailability and therapeutic efficacy of drug payloads [3] [4].

Finally, this lecture provides a vision on the future applications of formulations with multiple active and responsive nanoscale and microscale robotic platforms that are capable of performing diverse biomedical tasks, such as diagnosis, sensing, imaging, biopsy, and drug delivery. Ultimately, research on such multitasking microrobotic pills that combine many functions into a single oral device may lead to autonomous theranostic closed-loop 'sense and act' systems that would provide tremendous benefits for patients in clinical applications. There is plenty of room in the pill and thus several opportunities to keep incorporating multiple capabilities into this versatile vehicle.

References

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Figures

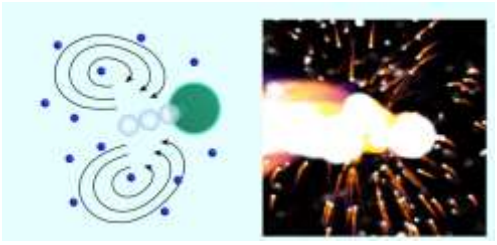

Figure 1: Mg-based microstirrer enhancing the fluid dynamics of a therapeutic payload.