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## Preliminary development of a magnetically actuated drug delivery system

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Magnetic actuated drug delivery and drug release are drawing more and more attention for noninvasive biomedical applications. Magnetic actuation enables targeted delivery to locations that are difficult to access by the conventional drug delivery systems. With proper tracking processes, it is expected to reduce the risk of the surgeries, minimize pain for the patients and reduce side effects. Techniques such as magnetic resonance imaging (MRI) has been introduced and widely used in the clinical applications. The technique has been proven to be safe for the human body in the meaning of scarcely affecting the internal environment of the body and is nearly transparent to the tissue as there are few ferromagnetic materials in the body. Targeted drug delivery is playing an important role in the modern medicine as their potential for minimizing invasive medical procedures. We report a preliminary design of electromagnetic actuation (EMA) system consisting of Helmoholz coil pairs and Maxwell coil pairs for targeted drug delivery and potentially drug release rate control. Preliminary testing indicates that the system is able to effectively move and align the magnetic particles in the desired direction within the region of interest. Calcium alginate microcapsule scontaining iron particles are used for the preliminary tests. One novel design of thermal sensitive and magneto-responsive microcapsule that is respective to the EMA system is illustrated.

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