

A Magnetic Actuation System for the Active Microrheology in Soft Biomaterials

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Abstract

Microrheology is a key technique to characterize soft materials at small scales. The microprobe is wirelessly actuated and therefore typically only low forces or torques can be applied, which limits the range of the applied strain. Here, we report a new magnetic actuation system for microrheology consisting of an array of rotating permanent magnets, which achieves a rotating magnetic field with a spatially homogeneous high field strength of ~ 100 mT in a working volume of $\sim 20 \times 20 \times 20$ mm³. Compared to a traditional electromagnetic coil system, the permanent magnet assembly is portable and does not require cooling, and it exerts a large magnetic torque on the microprobe that is an order of magnitude higher than previous setups. Experimental results demonstrate that the measurement range of the soft gels' elasticity covers at least five orders of magnitude. With the large actuation torque, it is also possible to study the fracture mechanics of soft biomaterials at small scales.

Keywords: *Magnetic field; Microrheology; Soft biomaterials; Wireless actuation*