Powerful actuation of magnetized microtools by focused magnetic field for particle sorting in a chip

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Abstract: This paper describes a novel powerful noncontact actuation of a magnetically driven microtool (MMT), achieved by magnetization of the MMT and focusing of the magnetic field in a microfluidic chip for particle sorting. The following are the highlights of this study: (1) an MMT was successfully fabricated from a mixture of neodymium powder and polydimethylsiloxane; the MMT was magnetized such that it acted as an elastic micromagnet with a magnetic flux density that increased by about 100 times after magnetization, and (2) a pair of sharp magnetic needles was fabricated adjacent to a microchannel in a chip by electroplating, in order to focus the magnetic flux density generated by the electromagnetic coils below the biochip; these needles contribute to miniaturization of an actuation module that would enable the integration of multiple functions in the limited area of a chip. FEM analysis of the magnetic flux density around the MMT showed that the magnetic flux density in the setup with the magnetic needles was around 8 times better than that in the setup without the needles. By magnetization, the drive frequency of the MMT improved by about 10 times-from 18 Hz to 180 Hz. We successfully demonstrated the separation of copolymer beads of a particular size in a chip by image sensing.

Author Keywords: Lab-on-a-chip; Magnetically driven microtools; MEMS; Microactuator; Sorting

Year: 2010
Source title: Biomedical Microdevices
Volume: 12
Issue: 4
Page : 745-752
Cited by: 5
Link: Scorpus Link
Document Type: Article
Source: Scopus

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