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Controlled deflection of diamagnetic biocompatible aqueous droplets.

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***Abstract*—**We present a microfluidic platform that is capable of controlled diamagnetic droplet displacement. In this method, monodisperse aqueous droplets are produced in a continuous phase of hydrophobic ferrofluid. Both phases are exposed to magnetic field. Precise deflection of the aqueous droplets is then achieved in a single step by adjusting the flow-rate of the disperse phase.

Microfluidics, diamagnetics, droplet control, biocompatible.

I. INTRODUCTION

Microfluidically generated droplets are readily used for the storing of biomaterials and biological analysis [1]. Control of these droplets using magentophoresis has emerged as a key technology in microbiology. Currently, the leading methods of droplet control by magentophoresis require the synthesis of biocompatible fluids and magnetic labeling, which is often time-intensive and costly [2].

Here, we present a fast, low-cost, and label-free alternative for the precise control of biocompatible droplets using negative magnetophoresis. We describe a ferro-hydrodynamic microfluidic system requiring only microchannels and a permanent magnet.

II. EXPERIMENTAL AND RESULTS

A. Devcie fabricaiton

We fabricated microfluidic polydimethylsiloxane (PDMS) channels based on a standard soft-lithography method. Then we introduced a permanent magnet parallel to the main channel of the device.

A magnetic fluid phase and a water phase were introduced to the system through the device inlets. Syringe pumps were used to control flow-rates of the fluids.

B. Fluid properties

The magnetic phase consists of oil-based ferrofluid, mineral oil, and a surfactant. The ferrofluid used contains magnetite nanoparticles with a 10 nm diameter [3].

C. Droplet Production and Control

A monodispersed stream of aqueous water droplets is achieved in the magnetic phase using a jetting regime. The external magnetic field attracts the magnetic medium of ferrofluid in the continuous phase. The attraction of this phase preferentially deflects the water droplets from their laminar flow. By simply adjusting the flow-rate of the dispersed aqueous phase, the degree of droplet deflection is precisely controlled.

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