Abstract

Keywords: ferrofluid, check valve, one-way valve

1 Introduction

Ferrofluid can be manipulated by electronically controlled magnetic fields to exert force on fluids[1, 2, 3]. This makes it possible to build pneumatic or hydraulic devices, perhaps on very small scales, such as a single chip[4, 5], to miniaturize fluid handling. This has been proposed for biomedical purposes[6] that would use water or body fluids, although this paper reports only on experiments done with air. Miniature pumps and valves could be used to make a "lab on a chip" (LOC) or even to heat or cool different chip areas.

2 Related Research

A number of papers report on ferrofluid pumps, focusing in particular on micropump and lab-on-a-chip applications[3, 7]. Many of these papers use a version of mechanical valve not based on passive ferrofluid, even though they move a ferrofluid bolus with a magnetic field. For example, a corrugated silicone micro valve[4, 8] has been reported. Other researchers use active valves, which require synchronization with the ferrofluid plug to form a pump, such as [9], which describes an active *T-Valve* with a moving ferrofluid plug, and [10] describes a complete fluid pump with valves that use active control of a ferrofluid bolus. At least two additional kinds of active valves, a *well valve* and *Y-valve*, have been described[11]. Active control is possible because the action of the plunger or bolus may be synchronized with the opening and closing of the valves. Nonetheless a passive valve would be simpler and less expensive, and would not require knowledge of the timing of the plunger.

An interesting functional micropump in which the moving ferrofluid bolus merges with a fixed ferrofluid valve and then separates on each pumping cycle has been described[5], but is not a one-way valve.

3 Conclusions

4 Acknowledgements

This paper was an outgrowth the the Passive Ferrrofluid Check Valve (PFCV) [12] reported by Veronica Stuckey and Robert L. Read. Veronica Stuckery 3D printed some of the apparatus.

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