Solid State Pump Using Electro-rheological Fluid
Technology #18205

Applications
- Micropumps for drug delivery, chemical analysis and biological sensing
- Micro-hydraulic systems
- Pitot tubes for pressure differential measurements

Problem Addressed
Micro-hydraulic technology is crucial to the design of micropumps for applications including chemical analysis, biological sensing and robots. We aim at addressing two primary problems for most micropumps: low efficiency and high cost miniaturization. First, considering the efficiency of microhydraulic systems, all types of pumps suffer from a low efficiency. For example, piezoelectric-actuated pumps have dominated reciprocating micropump technology because of their fast response time and precise dosage ability. However, this is a low-efficiency pumping mechanism, with efficiencies of around 0.1%. Second, miniaturization comes at a high cost. When mechanical pumps are scaled down to centimeters or millimeters, miniaturization is constrained by manufacturing technologies and pump specifications.

Technology
We design a device for pumping electro-rheological fluid, via an applied time-periodic voltage gradient. This novel approach involves exerting electromagnetic forces on induced dipoles distributed within the fluid and exploiting drag forces to drive flow in the channel. The electromagnetic force derives from the horizontal cross-channel electric fields, provided by a folded flexible printed circuit wrapped around the channel walls. These multiple independent electrodes are powered by a time-periodic voltage gradient. This device primarily consists of three layers of acrylic sheets of which the middle one contains a channel. A variation of the device with pitot tubes is capable of measuring pressure differentials by the difference of the heights of the fluid surfaces in the pitot tubes.

Advantages
- High efficiency pumping enables miniaturization of pumps
- Effective use of low shear stress behavior and dynamic response of ER fluid

Categories For This Invention:
Robotics

Intellectual Property:
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