Sensors and Materials, Vol. 17, No. 3 (2005) 097–112
MYU Tokyo

S & M 0590

Study of Valve-Integrated Microactuator Using Homogeneous Electro-Rheological Fluid

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(Received April 10, 2004; accepted December 15, 2004)

Key words: microactuator, homogeneous electro-rheological (ER) fluid, ER valve, micromachine, functional fluid, micromachining, diaphragm, gripper, polyimide, liquid crystal

For fluid-driven micromachines carrying out power-needing tasks such as maintenance in a limited space, a valve-integrated microactuator using a homogeneous electro-rheological (ER) fluid is proposed and developed. A valve using a homogeneous ER fluid whose viscosity is controlled by means of the applied electric field strength, termed the ER valve, consists of fixed electrodes and features a miniaturizable simple structure with high reliability. First, in this study, to realize high performance of the micro-ER valve fabricated by micromachining, the static and dynamic characteristics of the micro-ER valve with different nematic liquid crystals, bend numbers and electrode gap lengths are experimentally investigated. Second, a polyimide-diaphragm fluid microactuator whose structure is simple and without sliding parts is proposed, fabricated and tested. Third, an ER valve-integrated microactuator combining the fabricated 3-port micro-ER valve and a polyimide-diaphragm fluid microactuator is constructed with an effective size of 8.0×10×1.4 mm^3 and its characteristics are experimentally examined. Finally, a microgripper driven by the ER valve-integrated microactuator is fabricated and the drive is attempted.

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