

Development of Micro Optical Diffusion Sensor Using Opto-Dielectrophoresis

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Micro-electro mechanical systems (MEMS) biochips realizing high-speed and high-efficiency of reaction and analysis attract much attention in the medical as well as chemical fields. In particular, miniaturized devices enabling small sample volume, arrayed, and portable measurement may become a powerful tool for material analysis and process control. We have proposed a novel micro optical diffusion sensor (MODS) which enables small sample volume, high-speed and non-contact measurement of diffusion coefficient of liquid sample. In our method, a diffusion coefficient of liquid sample is measured by observing the decay of concentration diffusion. MODS consists of a pair of transparent electrodes (indium tin oxide or AZO), a photoconductive layer (amorphous silicon), two MEMS mirrors and excitation and probing fibers for inducing and detecting concentration distribution. The initial concentration distribution of sample is created by an opto-dielectrophoretic (opto-DEP) manipulation along with a sinusoidal pattern of irradiated beam on a photoconductive layer. In order to observe the diffusion process of the sinusoidal concentration distribution, the probing beam is irradiated to the excited area of the sample, and the first-order diffracted beam whose intensity is proportional to the contrast of the sinusoidal concentration pattern is detected. In this work, preliminary experiments of opto-DEP manipulation by fabricated DEP cell using polystyrene beads were demonstrated to confirm appropriate experimental conditions and device parameters such as an intensity and frequency of bias voltage. In order to reduce the negative effect of adsorption and aggregation of the beads, the amino-group was molecularly modified onto the channel substrate. The feasibility of the proposed device and the influence of the modified molecule on the measurement of the diffusion coefficient were reported.