Micro Optical Diffusion Sensor Using Laser-Induced Dielectrophoresis with Sputtered a-Si:H

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The mass diffusion coefficient is size- and construction-dependent parameter, therefore, the diffusion coefficient is a useful parameter for the observation of the conformational change and the bonding behavior of the molecule in the fields of the clinical diagnosis of neurodegenerative disease such as Alzheimer's disease. Several methods have been developed to measure the diffusion coefficient of the biological sample, however, a sensor applicable to point-of-care testing (POCT) has not been established because of the difficulties due to the requirement of high-speed measurement and small sensing device. In order to realize high speed, additives-free sensing with small sample volume, micro optical diffusion sensor (MODS) has been developed. In the measuring process, the concentration distribution is generated in micro-channel by laser-induced dielectrophoresis (DEP) that is a manipulation technique based on optoelectronic tweezers. For laser-induced DEP technique, a hydrogenated amorphous silicon (a-Si:H) is utilized as a photoconductive layer. In this work, a simple RF magnetron reactive sputtering method was applied as a new method to deposit an a-Si:H on the transparent electrode. Proposed RF magnetron reactive sputtering method is easy-to-use procedure compared with a plasma enhanced chemical vapor deposition using monosilane. The photoconductive layer was sputtered by several conditions, and the photoconductivity was experimentally evaluated. Moreover, the optical and structural property of the sputtered a-Si:H was measured by Raman spectroscopy, Fourier-transform infrared spectroscopy, and ultraviolet and visible spectrophotometer. The DEP cell was fabricated by the appropriate sputtering condition and succeeded in generating a concentration distribution of nano-sample, therefore the validity of the proposed a-Si:H by using the sputtering method has been confirmed. Furthermore, a new DEP cell with the sputtered a-Si:H was proposed. According to the numerical simulation, the force induced by DEP in the newly designed cell can be successfully generated.