Nano-sized sample analysis based on diffusion coefficient using optoelectronic microfluidic sensor

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The diffusion coefficient provide the information on the size, the conformation and the interaction of the nano-sized solute in a sample medium. Many diffusion sensing techniques have been developed, however, a sensing technique, which enables the compact, high-speed, sequential and multi-sample diffusion sensing device with a low sample consumption and applicable to the point-of-care testing (POCT), has not been accomplished.

In order to realize a microfluidic sensing chip satisfying these requirements, a microfluidic optical diffusion sensor (MODS) has been developed. The schematic of the proposed sensing chip, the measurement principle, and the measurement apparatus are shown in **Fig. 1**. The photoconductive layer (a-Si:H) is irradiated by the two-beam interference pattern of the excitation light, and an AC voltage is applied between transparent electrodes to produce the non-uniform electric field, then, the dispersed nano-sized samples are attracted to the illuminated line by the positive dielectrophoretic force, and a lattice-shaped concentration distribution, which works as a diffraction grating, is formed. In order to generate the diffracted light, the probing laser is illuminated, and the AC voltage and the excitation laser is stopped simultaneously. The diffusion coefficient is calculated by detecting the exponential decay of the 1st-order diffracted light because of the mass diffusion. For the sequential multi-sample measurement, the measurement sample is injected by a microfluidic injection system, and the measurement process is controlled by valves and optical shutters. In this study, the preliminary experiment for the sequential multi-sample measurement is reported.

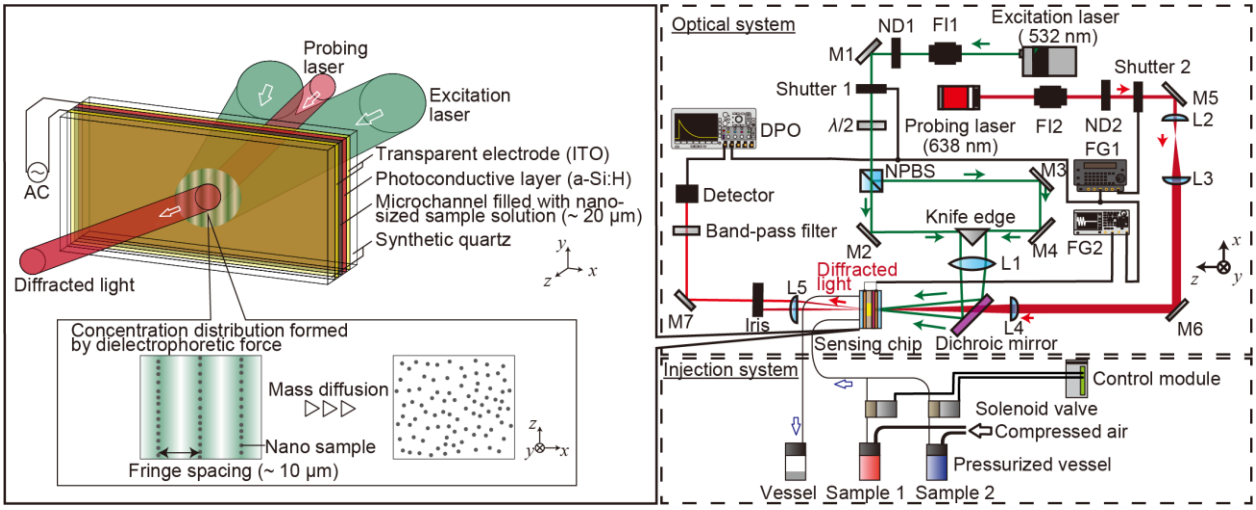

Fig. 1: Schematic of measurement principle using proposed sensing chip, and measurement apparatus.