

Development of pressure-sensitive channel chip for micro gas flows

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Abstract

Optical measurement techniques are useful for experimental studies on micro gas flows, which enable us to non-intrusively measure the flows with a high spatial resolution. The pressure-sensitive paint (PSP) technique, which is based on the emission of photons from luminophore, is a potential diagnostic tool for pressure measurement of micro gas flows. However, measurements by conventional PSPs are limited to the sub-millimeter order spatial resolution of ca. 200 μm , indicating the difficulty of the micro scale measurements. The present study proposes pressure-sensitive channel chip (PSCC) which is a micro channel with the capability of measuring pressure. We focused on the poly(dimethylsiloxane) (PDMS) micro-molding technique, which is one of the most popular techniques to fabricate a micro channel easily. Moreover, PDMS is a polymer used as a binder in PSP because of high optical transparency, gas permeability, and gas diffusivity. Thus, we developed a micro channel by the PDMS micro-molding technique with mixing a pressure-sensitive luminophore into PDMS: i.e. a micro channel fabricated by PSP, which is named PSCC. A flow through a micro converging-diverging nozzle with the throat width of 120 μm was demonstrated. The pressure distribution on the nozzle surface was successfully obtained by PSCC.