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Development of experimental visualization method for unsteady hydrodynamic stress field by using photoelasticity of liquid polymer¹

MASAKAZU MUTO, YOSHIYUKI TAGAWA, Tokyo University of Agriculture and Technology — The experimental visualization for the unsteady hydrodynamic stress field is in demand for the medical field, because the wall shear stress at the inner blood vessel may be the principal cause of the angiopathy. In this study, we develop a visualization method for the hydrodynamic stress field by introducing liquid polymers with photoelastic effects. Photoelasticity is a non-contact optical measurement method based on phase differences obtained by changes in the polarization state of the polymer solution, which results in proportional stress field values. In this experiment, to capture the photoelasticity phenomena at high frame rates, a high-speed polarization camera which contains the array of micro linear polarizers with four incident angles is used. As a result, we can observe an increase of phase difference of the liquid polymers (e.g. xanthan gum and carboxymethyl cellulose) in milli-channel when their flow rate is increased by syringe pump. Furthermore, the sensitivity of phase difference can be changed by the type and the concentration of the polymers. Especially, this method enables us to reveal the area of hydrodynamic stress concentration in the liquid, which other invasive (contact-type) point measurement steady methods may not capture.

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