DUAL-VIEW FLOW CHANNEL VISUALIZATION

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ABSTRACT

The concept of dual-view flow-channel visualization is proposed, where ordinary (top) and lateral images are available in a single view field. In order to obtain the top and lateral fluidic-channel images in a single view of the microscope observation, optical path lengths of these images were compensated by additional adjusting PDMS layer. In the transillumination observation, the lateral dark-field image and the top bright-field images were obtained simultaneously. The dual-view fluorescent observation of cultured HUVEC was also demonstrated.

KEYWORDS: Imaging, Lateral view, Embedded optics

INTRODUCTION

Various microscopic imaging methods have been investigated for deeper understanding of biology, chemistry, fluid dynamics, and so on. Under microscopic conditions, 3-D visualization is not so easy except several special techniques such as confocal laser-scanning microscopy. We have investigated embedding techniques of small-sized optics by utilizing simple microfabrication technologies [1,2]. By utilizing the techniques, a small prism may be embedded in the microfluidic chip with precise positioning and alignment. In this study, we have proposed a simple conception of 3-D (dual-view of horizontal and lateral images in a single view field) visualization of a microfluidic channel based on our optics-embedding techniques.

CONCEPT & DESIGN

Figure 1 shows the conception of the dual-view flow channel visualization. By embedding a prism in the proximity of a flow channel, dual-view of horizontal (*x-y* plane) and lateral (*x-z* plane) images are expected to be placed in a single view field of an objective lens.

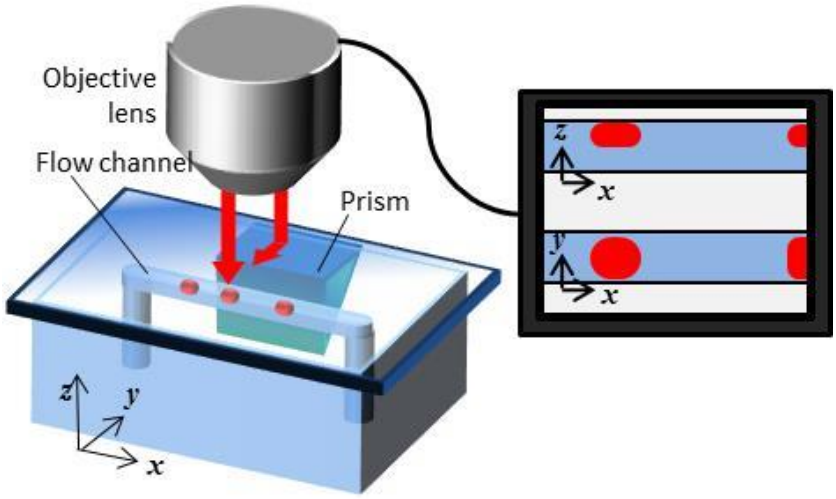

*Figure 1: Conception of dual-view flow-channel visualization. The horizontal (**x-y** plane) and lateral (**x-z** plane) views are simultaneously visualized.*

In order to realize the conception, a fluidic-and-embedded-prism device was designed. Figure 2 shows the design. For a commercially available 2-mm prism to be placed in the proximity to the fluidic channel, a spacing layer (~1.8 mm) is required. Furthermore, an optical path-length adjuster is placed to compensate the optical-path-length difference between the top and lateral observation.

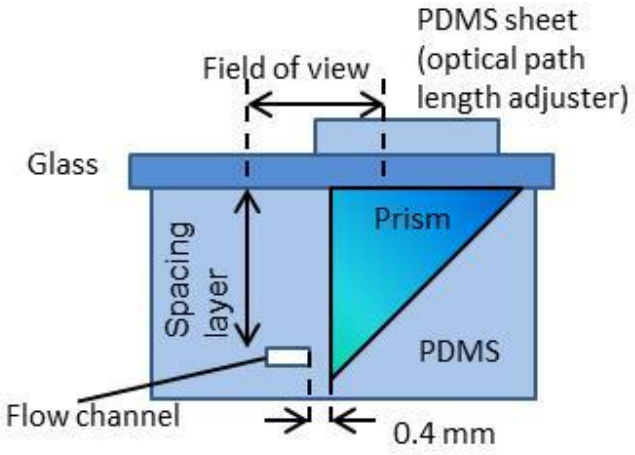

Figure 2: Design of dual-view visualization. Commercially available 2-mm prism is used. For the proximity between the channel and the prism, the spacing layer is placed. The upper PDMS sheet is used to compensate the optical path-length difference..

RESULTS AND DISCUSSION

Figure 3 shows micrographs of a straight channel by the dual-view method. Figure 3a shows a bright-field image with transillumination. The horizontal top and lateral views are successfully observed in a single field of view. Since the illuminated light does not transmit to the lateral view direction, the lateral view seems a dark-field image. Figure 3b shows a fluorescent image of cultured HUVEC with 5x objective lens. Although the nuclei are observed, fine structure of the cells cannot be dissolved in the present magnification. The present setup (spacing between the channel and the prism) is too large to use higher magnification observation. For biological cell application, we have to consider fabrication techniques for closer spacing between the channel and the prism.

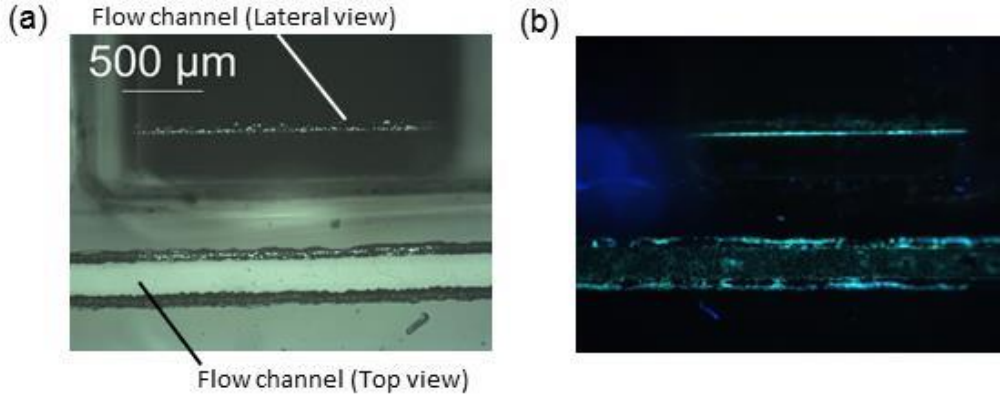

Figure 3: Micrographs of a straight channel by the dual-view method. (a) Transillumination bright field image of vacant channel. The lateral view seems a dark-field image. (b) Fluorescent image of cultured HUVEC.

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REFERENCES

[1] Y. Kazama, A. Hibara, "Integrated Angle-Resolved Spectroscopy with Novel Optics 'Caldera Mirror' " Proceedings of Micro Total Analysis Systems 2012, 55-57, 2012.

[2] Y. Kazama, A. Hibara, "Integrated Multi Beam Spectroscopy with Embedded Precise Optics," Proceedings of Micro Total Analysis Systems 2010, 1262-1264, 2010.

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