29p-D2-10

Space-selective metallization in three-dimensional microfluidic structures inside glasses using femtosecond laser

RIKEN, °Jian Xu, Dong Wu, Sizhu Wu, Koji Sugioka, Katsumi Midorikawa

E-mail: jxu@riken.jp; ksugioka@riken.jp

Integration of active components such as microelectronics in three-dimensional (3D) microfluidics is useful for developing new lab-on-a-chip devices. Typically, construction of metal based micro/nanostructures is desired for active microfluidics used for temperature control of target samples, electric-field stimulation of cells, and biochemical sensing based on plasmonics. However, using conventional planar photolithographic techniques for such integration will lead to high complexity of processing steps due to introduction of metal patterning process and fabrication of 3D microfluidics. Moreover, surface properties of patterned structures may change during bonding process. Therefore, developing a facile, flexible and free-bonding protocol for space-selective metallization in 3D microfluidics becomes necessary. In this paper, we report space-selective metallization in 3D microfluidic structures using femtosecond (fs) laser ablation and subsequent electroless metal plating. A new writing scheme in fs laser irradiation inducing homogenous ablation at the sidewall of 3D microfluidic structures is proposed for sidewall metallization. In-channel and sidewall fs laser ablation followed by electroless metal plating realizes flexible deposition of patterned metal films on desired locations inside microfluidics. In addition, space-selective heating which controls temperature for chemical reaction at the specific region inside microfluidics is demonstrated. Figure 1a describes schematics of laser backside ablation of sidewall for subsequent metal deposition created by the new writing scheme. Figure 1b presents a 45º tilted SEM image of sidewall after laser irradiation. As observed from the morphology of ablated area, homogeneous ablation at irradiated region of sidewall was formed. Figure 1c shows a 45º tilted SEM image of metal structures deposited on laser-ablated sidewall after electroless plating. Continuous metal lines from the front surface of glass to the bottom surface of microfluidic channel were formed only on the irradiated area, indicating the flexibility of this method.

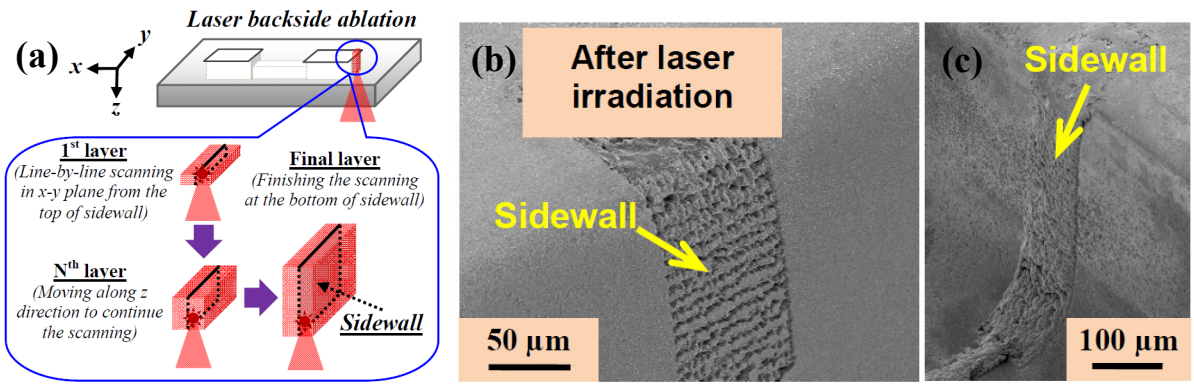

Figure 1 (a) Schematics of laser backside ablation of sidewall for subsequent metal deposition. Red volumes surrounding sidewall (dashed plane) show irradiated regions by line-by-line scanning in x-y plane with multiple layers along z direction. (b) 45º tilted SEM image of sidewall after laser ablation; (c) 45º tilted SEM image of sidewall after electroless plating.

© 2013 年　応用物理学会