LIPSS formation on transparent material by laser-induced plasma-assisted ablation (LIPAA) and its fundamental characteristics

Koshi Kudo[1], Muma Miura[1], Sohei Yamada[1], Kotaro Obata[2], Koji Sugioka[2], and Yasutaka Hanada[1,*]

[1] Hirosaki University Faculty of Science and Technology, 3 Bunkyo-cho. Hirosaki, Aomori 036-8561, Japan
[2] RIKEN Center for Advanced Photonics (RAP), 2-1 Hirosawa, Wako-shi, Saitama 351-0198, Japan
*Corresponding author email: y-hanada@hirosaki-u.ac.jp

The laser-induced plasma-assisted ablation (LIPAA) achieves high-quality surface microfabrication of transparent materials [1]. In the LIPAA process, strong interactions between laser light and plasma results in ablation and selective metallization on the rear side of the transparent substrate in micrometer scale. We focused on the metal thin films deposited on the transparent substrate during LIPAA process and explored the possibility of transferring the laser-induced periodic surface structures (LIPSS) on the substrate. In this presentation, we investigated the fabrication characteristics of LIPSS on a glass by the LIPAA process using a nanosecond (ns) laser.

Figure 1(a) shows a schematic illustration of LIPAA process. In the experiment, a Cu plate was placed below a glass slide. The distance between the glass and the Cu plate can be varied from 0 to 100 μm. The LIPAA process was performed by irradiating a focused ns laser (1064 nm, 5 ns, 10 Hz) on the Cu surface. Figure 1(b) shows scanning electron microscopy images of the rear side of the glass after the LIPAA process. A laser energy, the number of pulse and a Cu-glass slide distance were 30.0 μJ/pulse, 1 pulse and 0 μm respectively.

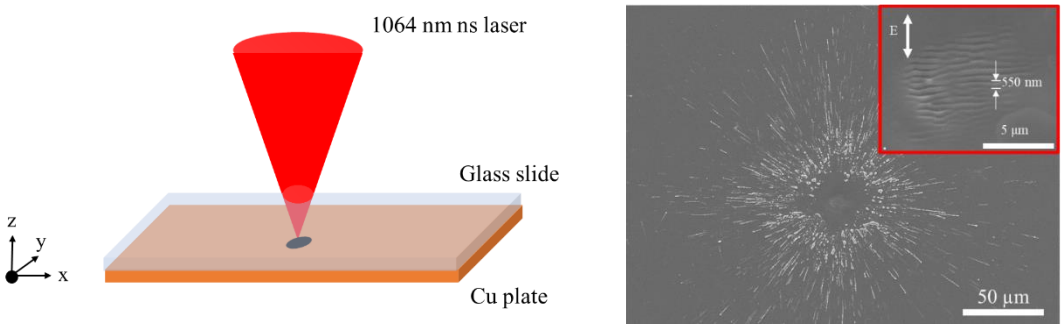

Figure 1 (a) Experimental setup of LIPAA process. (b) Low-magnification (left) and enlarged (inset) LIPSS images.

In Fig. 1(b), LIPAA process with single shot laser irradiation achieves LIPSS formation with periods of about 550 nm on the rear side of the glass, which is superior to the conventional LIPSS formation by a ns laser irradiation of pre-deposited metal thin films on a glass. In addition, no damage was observed on the fabricated areas. The periods can be controlled by changing the experimental conditions such as pulse energy. In this presentation, we report the details of LIPSS formation on the glass using the LIPAA process.

Reference:

[1] Y. Hanada et al., Development of practical system for laser-induced plasma-assisted ablation (LIPAA) for micromachining of glass materials, Appl. Phys. A, 79, 1001-1003, (2004)