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Oct. Oct. 6(Thu.) [Poster Session I]

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[Poster Session I]

Oct. 6(Thu.)

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Ablation depth control on ITO-glass using beam shaped femtosecond laser

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We report on the ablation depth control with a resolution of 40 nm on indium tin oxide (ITO) thin film using a square beam shaped femtosecond (190 fs) laser (λp = 1030 nm). A slit is used to make the square, flat top beam shaped from the Gaussian spatial profile of the femtosecond laser. An ablation depth of 40 nm is obtained using the single pulse irradiation at a peak intensity of 2.8 TW/cm2. The morphologies of the ablated area are characterized using an optical microscope, atomic force microscope (AFM), and energy dispersive X-ray spectroscopy (EDS). Ablations with square and rectangular types with various sizes are demonstrated on ITO thin film using slits with varying x-y axes. The stereo structure of the ablation with the depth resolution of approximately 40 nm is also fabricated successfully using the irradiation of single pulses with different shaped sizes of femtosecond laser.

KEYWORDS : Ablation depth control, ITO-glass, Beam shaping, Femtosecond laser

1. Introduction

Indium tin oxide (ITO) is the widely used as transparent conducting oxide (TCO) for fabrication of optoelectronic products such as flat-panel displays, touch panels, solar cells and organic light emitting devices (OLEDs) because of their high electrical conductivity and high transmittance in the visible and near IR (infrared) wavelength range [1]. In order to enhance optical transmittance for cutting back power consumption as well as reducing the resistance to improve electrical conductivity of ITO thin films, finding ways to control micromachining depth of ITO thin films deposited on substrates as glass or PET is highly significant role in the field of displays fabrication and assembly. Therefore, it is necessary to develop direct patterning strategy without patterning mask to control forming depth with well-defined morphology on ITO thin films.

2. Experimental Preparation

Information of the experimental sample is shown in Fig. 1. ITO thin films with a thickness of approximately 150 nm and a transmissivity of 90.5 % were deposited on the glass substrates using a DC magnetron sputtering system. In this experiments, The ITO thin films were patterned using a commercial regenerative amplified mode-locked Yb:KGW laser with a central wavelength of 1030 nm, a pulse width of ~200 fs, a repetition rate of 30kHz, and maximum pulse energy of 66uJ. An objective lens with 0.42 NA is used for experiments. A Gaussian laser beam was passed through slit, Gaussian beam was shaped to quasi-flat top beam by slit. The shaped quasi-flat top beam had square type shape. In this present, the following laser ablation experiments are conducted to control ablation depth of ITO thin film on the glass substrate using shaped quasi-flat top beam, and to accomplish selective ablation between ITO thin film and glass substrate.

Fig. 1 (a) Photograph of sample and (b) sample information

3. Conclusions

In this study, experiment has described single pulse control using shaped quasi-flat top beam by slit for controlling ablation depth. Fig. 2 shows the optical microscope images of morphology on the ablated ITO thin film. The damage threshold both ITO thin film and glass substrate were measured in order to avoid damage on the glass, so that conduct selective ablation successfully. We selectively controlled forming depth and removed the ITO thin films with thickness 150nm on glass substrates. In particular, we observed when the 6 pulses number at 2.8TW/cm^2.

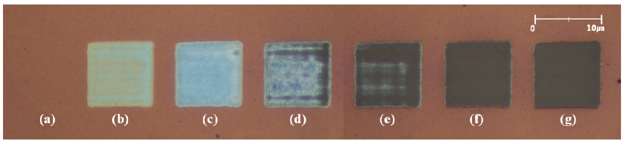

Fig. 2 Optical microscopic views of morphology on albated ITO film by NIR femtosecond laser irradiation with each different pulse shots; (a) 0 shots (b) 1 shot (c) 2 shots (d) 3 shots (e) 4 shots (f) 5 shots (g) 6 shots.

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