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In Situ Monitoring of Thermal Radiation of Tin-Doped Indium Oxide Thin Films Under Excimer Laser Irradiation

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Excimer laser irradiation of tin-doped indium oxide (In_2O_3:Sn, ITO) thin films is an interesting process that enables laser annealing, melting/solidification, ablations, and etching/patterning of ITO thin films simply by changing laser fluence.[1] However, laser-processing parameters are very sensitive to the properties of ITO thin films and underlying substrates. Therefore, the development of an *in situ* monitoring method of excimer laser irradiation processes will be useful to assist the development of the laser processing of ITO thin films. In this purpose, commercially available ITO thin films (thickness h = 200 nm) on glass substrates were used as test specimens. The specimens were irradiated with a XeCl excimer laser. The thermal emissions from specimens under the irradiation of the laser pulses were detected with an amplified InGaAs photo diode (PD). Further details of the measurement will be available elsewhere.[2] Surface morphology of irradiated ITO thin films was observed by atomic force microscopy (AFM).

Figure 1 shows thermal emission signals from ITO thin films under laser irradiations measured *in situ* with the PD. Interesting findings are that the decay curve did not decrease monotonically above laser fluence F = ~300 mJ/cm^2 as shown by the arrows in Fig. 1. Figure 2 shows surface morphology of laser-irradiated ITO thin films. The surface morphology did not change significantly below F = 300 mJ/cm^2 as shown in Fig. 2a. Meanwhile, the surface morphology drastically changed above F = 300 mJ/cm^2 as shown in Fig. 2b, suggesting melting and solidification of ITO thin films above F = 300 mJ/cm^2. Therefore, the non-monotonic decay observed in Fig. 1 can be associated with a recalescence behavior of ITO thin films during rapid solidification.

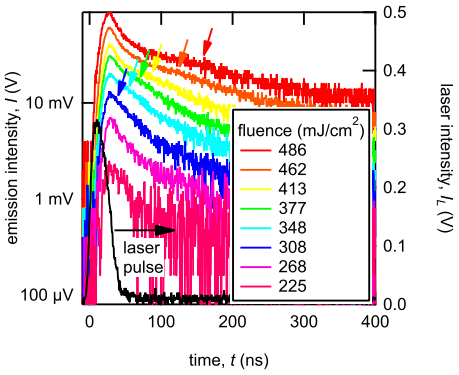

Fig. 2: Intensity of thermal emission collected from ITO thin films under the irradiation of a XeCl excimer laser with an InGaAs detector.

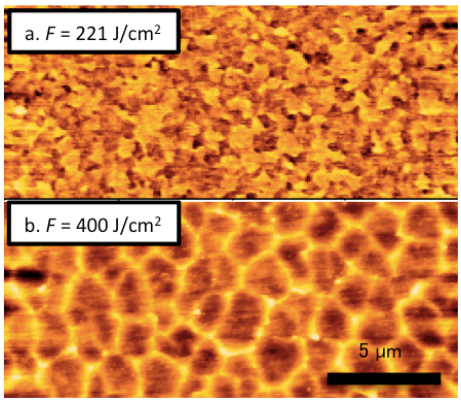

Fig. 2: AFM images of surface morphology of ITO thin films irradiated at (a) F = 221 J/cm^2 and (b) F = 400 J/cm^2.

1) T. Tsuchiya et al.: Appl. Phys. A 99 (2010) 745, 2) K. Shinoda et al.: Appl. Phys. B, in press.