Laser processing and ablation plasma temperature of organic thin film

Norio Tsuda, Shusuke Ono, Kumar Palanisamy,
Vijay Srinivasan, Jun YAMADA, Shizuyasu Ochiai
Aichi Institute of Technology,
1247 Yakusa-cho Yachigusa Toyota 4700392, Japan

The improvement of power generation efficiency of solar cell organic thin film has been advanced significantly. The large area of the solar cell organic thin film is easy and the production cost is low. However, the solar cell organic thin film is vulnerable to heart. Therefore, the organic thin film has difficulty in secondary processing. The laser proceesing of organic thin film using a femtosecond laser has been studied for secondary processing.[1]

The femtosecond laser is ALPHA10 manufactured by Thales laser. The wavelength is 800nm, the half pulse with is 100fs and the peak power is 1TW. On the other hands, a YAG laser as the nanosecond laser is used. The wavelength is 1064nm, the half pulse width is 15ns and the peak power is 23MW. A spectroscope HR4000 manufactured by Ocean optics is used to measure the ablation plasma spectrum. The wavelength resolution is 0.53nm. The measurement timing is synchronized the single pulsed-laser emission. The sample is made by spin coating method.[2] The organic thin film of PCDTBT, PCPDTBT, P3HT, PC61BM is used. Laser processing depth and area are observed by a laser-microscope of Taylor Hobson.

The femtosecond laser and the nanosecond laser are respectively focused on organic thin film. The laser ablation plasma temperature distribution is calculated by Boltzman plot method. The peak of femtosecond laser ablation temperature is arroud 1mm upper from surface of the PCPDTBT organic thin film and the temperature reaches 1.1eV. On the other hands, the nanosecond laser ablation temperature is rising with increasing the height from surface of PCPDTBT organic thin film and the temperature reaches 6eV, because the laser ablation plasma makes heated again by laser pulse. The femtosecond laser processed area is smaller than the nanosecond laser processed area.

The femtosecond laser processing efficiency is lower than the nanosecond one. However, femtosecond laser processing is better for micro-processing than the nanosecond laser processing.

References

[1] T. Kurata, N. Tsuda, J.Yamada, S. Ochiai, *The review of laser engineering* **41**(5), pp.356-360, (2013).(in Japanese)
[2] S. Ochiai et al., *Electron. Mater. Lett.* **9**(4), pp.399-403, (2013).

Acknowledgement

This work is supported by MEXT Private University Project Grant under contract # S1001033