Laser processing of organic wood-plastic composite materials

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Using natural renewable resources to manufacture electronic devices is a common goal of engineering and materials science. The application of laser processing is becoming increasingly widespread [1,2]. The direct fabrication of highly conductive, intrinsically flexible, and green microelectrodes from naturally fallen leaves in ambient air using femtosecond laser pulses without any additional materials has been reported [1]. Wood–plastic composites (WPCs) are composite materials made of wood fiber/wood flour and thermoplastic. WPCs are sustainable and environmentally friendly materials because sustainable wood supplies are used [3]. In this study, we demonstrate the laser-induced carbonization on WPCs using a laser processing technique.

We used a Yb:KGW femtosecond laser with an optical parametric amplifier (OPA) to irradiate WPC materials at various wavelengths from 320 nm to 1040 nm with a scan speed of 250 μm/s. The fluence used in the experiment was 1.1×10^{4} ~ 1.3×10^{6} mJ/cm^2, and the setup is shown in Fig. 1. Laser-induced color change from brown to black was observed at the excitation wavelength of 320 nm and power of 10 mW as shown in Fig. 2. This result suggests the occurrence of laser-induced carbonization. In the presentation, we will discuss the wavelength and excitation density dependence of laser-irradiated WPC samples and show the results of terahertz time-domain spectroscopy used to check the change in conductivity.

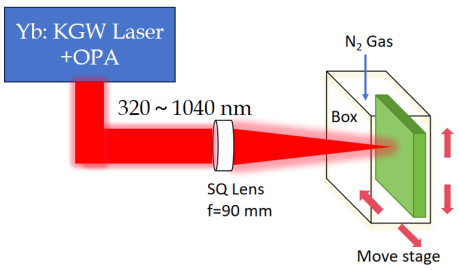

Figure 1: Experimental setup

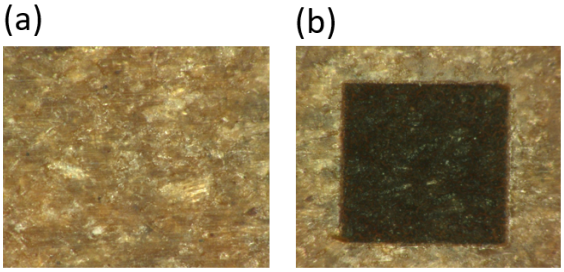

Figure 2: Photos of WPC sample before (a) and after (b) laser irradiation.

References:

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