Three Dimensional Optical Data Storage in Polymers Using Femtosecond Laser Pulses.

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The fast growing demand for high data storage capacity has stimulated research on development of innovative technologies and new storage materials. In conventional optical discs data storage is mostly confined to the surface of polycarbonate (PC). However, storing information bits in a multi-layer structure using the three dimensional (3D) volume of the disc can overcome this limitation and provide ultra-high storage capacities. A femtosecond pulse, with intensities in the order of 10^{12} W/cm^2, is to lead to optical breakdown causing permanent modification in the material. With such high intensity and since polymers have high band gaps; the interaction is completely nonlinear thus the material can be modified locally on the surface and in bulk. The irradiated regions exhibit fluorescence as shown in figure1 (a). This feature can be exploited to demonstrate three dimensional high-density data storage in Polymethyl methacrylate (PMMA) without any special material preparation. In this study, pixel by pixel data writing was achieved by focusing femtosecond laser beam inside PMMA and other polymers such as polycarbonate, and polystyryne. The pulse energy is altered according to grey scale of the written data using computer software written for this purpose. The reading system contain fluorescence confocal microscope by which data can be read only from specific layer. We demonstrate up to 20 layers of embedded data that can be stored in a standard 120 mm disc. Storage capacity of 0.2 TBytes/disc can be achieved by adjusting read laser parameters. In this study, parameters such as depth, temperature was investigated. Effect of depth is shown in figure1(b), in which the picture of maple leave.was written by femtosecond laser pulses inside PMMA at different depth. The second picture (ii), was taken at 200μm from the surface while the third picture (iii) is for layer written at 360 μm.

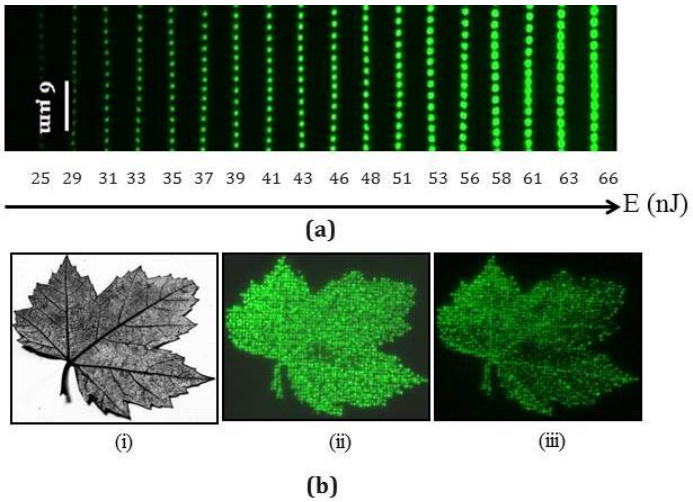

Figure 1: Confocal fluorescence microscope image of ultra-fast laser modified regions. Fluorescence at different depth. i. Grey image (8 levels) of maple leaf used for fabrication at different depths in PMMA. ii, iii. Fluorescence images of maple leaf at 200, and 360μm below the surface.