PHOTOPRIMARY PROCESSES AND NANOMETER-NANOSECOND MORPHOLOGICAL DYNAMICS OF ORGANIC POLYMER FILMS BY PUMP AND PROBE EXPERIMENTS

Hiroshi Masuhara, Takashi Mito, Tomokazu Masubuchi, Koji Hatanaka, and Hiroshi Fukumura

Dept. of Appl. Phys., Osaka University, Suita 565-0871, Japan

Studies on intense nanosecond excimer laser excitation of polymer films have received much attention because of its photochemical interest and high potential for future application to microfabrication. High density excitation leading to annihilation between excited states, multiphoton ionization, cyclic multiphotonic absorption, and so on takes place and results in efficient photothermal conversion. Local and rapid heating of polymer materials results in melting, phase transition, etching, and ablation. Photochemical approach by fluorescence spectroscopy, transient absorption spectroscopy, and photoacoustic measurement is very useful to analyze their microscopic mechanism. Actually we have devoted our efforts to bridge the gap between photophysics/photochemistry and laser ablation/microfabrication, and some of which will be demonstrated.

One of our recent trials reveals that polymer films undergo expansion before ablation, and also expansion and contraction even below ablation threshold.[1-3] The morphological dynamics has been directly measured by our time-resolved interferometry and analyzed in relation to elastic coefficient, glass-rubber transition, molecular weight, and free volume of polymer films. Particularly the following topics will be demonstrated and discussed.

1) Molecular weight dependence of expansion of polystyrene film

2) Oscillatory expansion and contraction behavior of poly(methyl methacrylate) film

3) Ablation and decomposition dynamics of polyimide, polyurethane, and nitrocellulose films.

[1] Furutani, H.; Fukumura, H.; Masuhara, H. *J. Phys. Chem.* **1996**, 100, 6871.

[2] Furutani, H.; Fukumura, H.; Masuhara, H.; Lippert, T.; Yabe, A. *J. Phys. Chem. A.* **1997**, 101, 5742.

[3] Furutani, H.; Fukumura, H.; Masuhara, H.; Kambara, S.; Kitaguchi, T.; Tsukada, H,; Ozawa, T. *J. Phys. Chem. B.* **1998**, 102, 3395.