Evaluation of two-photon polymerization reaction with confocal Raman microscopy

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In this presentation, we present quantitative analysis of polymerization reactivity by means of confocal Raman microscopy. Figure 1 shows time evolution of Raman spectrum of methy-methacrylate during polymerization reaction. A peak at 1640 cm\(^{-1}\) corresponds to stretching vibration mode of C=C, which decreases in proportion to progression of polymerization reaction. We performed confocal micro-Raman imaging at 1640 cm\(^{-1}\) for two-photon polymerization-fabricated microstructures. We observed that laser power for two-photon photopolymerization affects the degree of polymerization reaction progression as shown in Figure 2. We also found that the degree of polymerization was not uniform in the whole volume of polymerized structures, but different at deep inside and near the surface of the structures. So far, evaluation of two-photon micro/nanofabrication has mainly done only by shape observation using scanning electron microscopy (SEM). Since polymerization degree is directly related to various physical and chemical properties of polymer, such as elasticity, stiffness, refractive index, density, and so on, Raman imaging gives us additional information for analyzing those properties of nano-sized polymer [1].


Fig. 1. Time evolution of Raman spectrum of methyl methacrylate during photo polymerization.

Fig. 2. Power dependence of polymerization reactivity in two-photon photopolymerization.