

Nanoscale Patterning of Self-assembled Monolayer on Membrane Structure by Near-field Photothermal Desorption

Mao Jinde^{C, S}

School of Integrated Design Engineering, University of Keio, Kouhoku-ku Yokohamashi, Kanagawa, Japan
jinde@naga.sd.keio.ac.jp

Yoshihiro Taguchi

Department of System Design Engineering, University of Keio, Kouhoku-ku Yokohamashi, Kanagawa, Japan

We have developed a nanoscale patterning method of a self-assembled monolayer (SAM) by using a near-field light. SAM is an organic thin film which is formed on a substrate surface, and surface characteristics can be changed easily. Furthermore, SAM is formed by intermolecular force self-assembly, therefore it has high uniformity and quality. For these reasons, SAM has gained much attention, because of the great potential in various scientific and engineering fields. Hence, we have proposed a non-contact and non-contaminated patterning method of SAM at nanoscale by using near-field photothermal desorption (NPTD). In NPTD method, a short-pulsed irradiation with a near-field light is performed, and the surface is locally heated at nanoscale by photothermal effect. Then, SAM molecule is desorbed from the substrate completely by breaking chemical bondings between SAM and substrate. In this study, near-field light is excited at a tip of the near-field optical fiber with small aperture. In our previous configurations, the temperature rise of sample surface caused by the near-field photothermal effect is not sufficient because of the significant heat loss toward the substrate. When high intensity laser was coupled into the fiber in order to enhance the intensity of the near-field light, the small aperture at the near-field optical fiber was damaged. Therefore, we have proposed a new sample structure which can achieve high-efficient heating of the sample. By adopting the membrane structure, a heat loss can be prevented. A simple preliminary experiment by using the membrane shows a validity of the photothermal desorption of SAM. In addition, the temperature distribution with irradiating near-field light is calculated by the finite difference time domain method. As a result, the surface temperature at the membrane is higher than our conventional configurations, and it shows the feasibility of the nanoscale patterning of SAM by the near-field photothermal effect.