

Formation of Striped Periodic Surface Structures using Circularly-Polarized Femtosecond Laser

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Laser-induced periodic surface structure (LIPSS) is a periodic structure that is spontaneously formed by the irradiation with laser on the surface of solid materials. Linearly polarized laser pulses are often used in LIPSS research, and in this case, striped LIPSS is formed. In the 1980s, the so-called Sipe theory [1], which explains the dependence of the period on the angle of incidence, was established. In the late 1990s, however, the formation of LIPSS with a period shorter than that predicted by the Sipe theory was reported by irradiation with femtosecond laser pulses.

On the other hand, it is known that a periodic structure consisting of dots is formed when a circularly polarized laser pulse is irradiated. In this case, the distance between the nearest dots is roughly constant, and the dots are arranged in a hexagonal lattice-like structure but without long-range order. Recently, we have reported formation of a square lattice-like LIPSS on a unidirectionally scratched surface of stainless steel in small region [2].

We found formation of striped LIPSS by circularly polarized femtosecond laser pulses. The laser used was a Yb:KGW laser (Pharos; Light Conversion) with a wavelength of 1.03 μm and a pulse width of 290 fs. The laser was irradiated at normal incidence while scanning the irradiation point with a galvanometer scanner. The sample was a mirror-polished silicon substrate. An example of formed LIPSS is shown in Figure 1. A striped periodic structure was formed, with each stripe perpendicular to the scanning direction and with a period approximately equal to the laser wavelength. The striped structure did not appear without scanning, and the direction of the stripes was perpendicular to the scanning direction. Such a striped LIPSS with scanning circularly polarized laser pulses has already been reported [3].

In this presentation, we report that when the light is obliquely incident, the stripe structure becomes tilted, and the period also changes. Based on this phenomenon, we discuss the formation mechanism of the stripe structure.

References:

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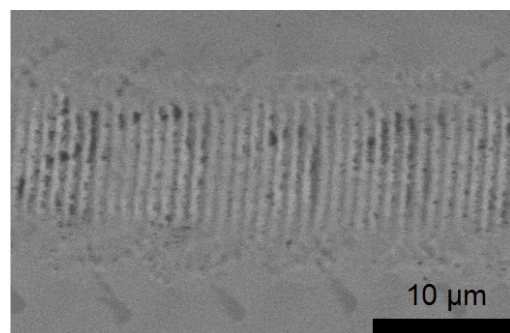


Figure 1: LIPSS formed by irradiation with circularly-polarized femtosecond laser while scanning.