第77回応用物理学会秋季学術講演会 講演予稿集 (2016 朱鷺メッセ (新潟県新潟市))

Wet etching on Rear Surface of a Silicon Substrate assisted by an Infrared Femtosecond Laser

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Silicon (Si) is a semiconductor material that is increasingly used in modern technologies such like microelectronics, MEMS, and photonics. Si is an opaque material in visible to near-infrared wavelength region but it transmits light longer than 1127nm, which corresponds to its band gap energy of 1.12eV. Therefore, Si can be considered as a transparent material for radiations longer than this wavelength. We have studied a laser processing of Si via non-linear absorption processes using an infrared femtosecond laser at 1552nm. The laser was focused on the rear surface of a 320μm thick Si substrate. It has been shown that machining on the Si rear surface was possible while the front surface of the Si, where laser pulses were impinged, showed no change. However, only a shallow groove was formed along the processing line: its depth was about 170nm or less. To increase the machining rate, we implemented laser-assisted wet-etching using KOH solution. It is expected that when the laser is focused to the Si rear surface, where it is contacting with KOH solution, wet etching would occur due to the temperature rise caused by the laser irradiation. The depth of the groove formed became a few micrometers. The effects of laser irradiation conditions on machined grooves were examined. With lower scanning speed or higher laser repetition rate, the overlap rate of the pulses increases and the groove becomes deeper. Furthermore, the deeper grooves seem to occur while focusing the laser approximately 10μm into the KOH side rather than near or inside the Si rear surface. Additionally, when the Si rear surface and KOH was allowed to react each other prior to the laser irradiation, the etching occurred more efficiently.

Topic: Strong Light Excitation Phenomena Applied to Materials and Bio Engineering
Keywords: Silicon, rear surface, KOH etching, femtosecond laser.