Effect of Laser Parameters on Semiconductor Micromachining Using Diode-Pumped Solid-State Lasers (M604)

Mingwei Li, Spectra-Physics, Inc., Mountain View, California, USA;
Kevin Hartke, Mound Laser & Photonics Center, Inc., Miamisburg, Ohio, USA

Abstract

Laser micromachining of semiconductor materials such as silicon and sapphire has attracted more and more attention in recent years. High precision laser cutting and drilling processes have been successfully used in semiconductor, photonics, optoelectronics, and microelectromechanical system (MEMS) industries for applications including wafer dicing, scribing, direct via forming, and three-dimensional structuring. In the current study, two Q-switched and one mode-locked diode-pumped solid-state (DPSS) 355 nm lasers have been used to scribe grooves on silicon and sapphire wafer substrates at different pulsewidths (10 ns, 32 ns, and 10 ps) and pulse repetition rates (30 kHz, 40 kHz, 50 kHz, and 80 MHz). Experimental results have been compared between different pulsewidths, power levels, and pulse repetition rates. It has been found that at the same average power and same repetition rate, the grooves scribed by the longer pulsewidth laser are deeper, while the shorter pulsewidth laser produces better quality cuts. However, the same short pulsewidth Q-switched laser can produce deeper cuts by increasing its repetition rate and power. The implications of these results are then discussed.

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