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電子励起領域への光吸収による透明材料の超高速レーザー加工

Ultrahigh-speed laser processing of transparent materials through transient electronic excitation

(講師) 伊藤 佑介
Prof. Yusuke ITO

東京大学 工学部, 准教授
School of engineering
The University of Tokyo

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The use of glass substrates is promising in next-generation semiconductors, but their hardness and brittleness make processing extremely difficult. While etching methods are becoming mainstream, their complexity and environmental impact are concerns. Laser processing has emerged as a promising alternative, yet conventional methods require several tens of seconds to drill a single micro through-hole (depth >1 mm, diameter <100 μm).

In this study, we demonstrate an ultrafast technique—over one million times faster than conventional methods—by combining our previously developed Transient and Selective Laser (TSL) processing with a Bessel beam. A picosecond Bessel beam generates a transient excited channel inside the glass, where a subsequent microsecond Bessel beam is selectively absorbed. This enabled formation of 3 μm diameter through-holes in 1 mm-thick glass within 20 μs. The technique offers tunable control and is expected to advance glass substrate processing in future semiconductor devices.

Pre-registration