TGV Direct Laser Drilling for next-generation electronics

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The rapid advancement of electronic devices has created a growing need for innovative manufacturing techniques to produce through-glass vias (TGVs) with high precision, minimal size, and strong reliability. TGVs are becoming critical components in industries such as microelectronics, optoelectronics, telecommunications, aerospace, and defense, where compact designs and superior performance are essential. Among the emerging fabrication methods, femtosecond laser drilling has garnered significant attention for its ability to meet these demands with exceptional accuracy and processing speed.

This study highlights progress in using femtosecond laser technology to fabricate high-aspect-ratio, taper-free TGVs. We developed a single-step drilling process that eliminates the need for post-processing, which drastically improves efficiency compared to conventional methods like focused ion beam drilling. This approach eliminates the need for chemical etching with aggressive solutions, making it environment friendly. By fine-tuning laser parameters, such as pulse energy and repetition rate, we successfully achieved aspect ratios up to 20:1 and produced sub-50 µm holes with no taper. Additionally, this process demonstrated the ability to drill through substrates thicker than 0.5 mm at high speeds, without inducing cracks or compromising structural integrity.

The research utilized ultrashort laser pulses of less than 200 µJ at a 1030 nm wavelength (Jasper X0, Fluence, Poland), emphasizing the importance of optimizing laser parameters over simply increasing laser power to achieve high-quality results. The study also shows that carefully balancing laser settings can greatly enhance processing speed and precision, making femtosecond laser drilling a superior choice for TGV fabrication.

These findings underscore the transformative potential of femtosecond laser technology for producing TGVs, enabling the development of more compact, efficient, and high-performance electronic components. This advancement holds the promise of driving innovations in electronics, further shrinking device sizes while improving functionality across a range of high-tech industries.