Ultrafast laser drilling of TGVs in glass interposers for advanced semiconductor packaging

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Through-glass vias (TGVs) are needed in advanced semiconductor packaging to manufacture cutting edge glass interposers to replace conventional packaging technologies for next generation chip integration . In the last decade, several techniques for TGV formation have been adopted based on DRIE and wet etching and laser ablation. However, especially in the UK, there is no supply chain service to manufacture low volume customised glass interposers. Our UK funded Interpose-UK project is addressing this gap by enabling bespoke laser based manufacturing of vias with varying parameters such as diameter, depth, and 3D shape at high quality and minimal cost.

In this work, we used an ultrafast laser centered at 1030 nm operating in different temporal pulsing modes (single-pulse, MHz-burst, and GHz-burst) to compare percussion drilling performance. We initially targeted a wide range of via diameters of 10s µm through 300 µm thick borosilicate Glass (BF33) but are also considering l higher aspect ratio vias below 10µm diameter in other glasses. We varied the incident laser pulse energy and number of laser pulses on target for laser pulse durations ranging 250fs-10ps across varying laser repetition rates and operating modes. It is possible to drill high-density crack-free TGVs. Ablative TGVs vias can be drilled extremely fast at microsecond to millisecond rate per via depending on via size and aspect ratio/wafer thickness. The physical laser drilling mechanism varies across the different technologies and we will discuss the merits of each one. Demonstrations of custom glass interposers incorporating the newly developed laser technology will be delivered next at our end user project partners facilities.