Through-Glass Vias for MEMS Packaging

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Novelty / Progress Claims We have developed a new method for fabrication of through-glass vias (TGVs). The method allows rapid filling of via holes with metal rods both in thin and thick glass substrates.

Background Vertical electrical feedthroughs in glass substrates, i.e. TGVs, are often required in wafer-scale packaging of MEMS that utilizes glass lids. The current methods of making TGVs have drawbacks that prevent the full utilization of the excellent properties of glass as a package material, e.g. low RF losses. Magnetic assembly has been used earlier to fabricate through-silicon vias (TSVs), and in this work we extend this method to realize TGVs[1].

Methods The entire TGV fabrication process is maskless, and the processes used include: direct patterning of wafer metallization using femtosecond laser ablation, magnetic-field-assisted self-assembly of metal wires into via holes, and solder-paste jetting of bump bonds on TGVs.

Results We demonstrate that: (1) the magnetically assembled TGVs have a low resistance, which makes them suitable even for low-loss and high-current applications; (2) the magnetic-assembly process can be parallelized in order to increase the wafer-scale fabrication speed; (3) the magnetic assembly produces void-free metal filling for TGVs, which allows solder placement directly on top of the TGV for the purpose of high integration density; and (4) good thermal-expansion compatibility between TGV metals and glass substrates is possible with the right choice of materials, and several suitable metals-glass pairs are identified for possible improvement of package reliability[2].

[1] M. Laakso et al., IEEE 30th Int. Conf. on MEMS, 2017. DOI:10.1109/MEMSYS.2017.7863517
[2] M. Laakso et al., "Through-Glass Vias for Glass Interposers and MEMS Packaging Utilizing Magnetic Assembly of Microscale Metal Wires," *manuscript in preparation*