

**Professor M.Esashi was awarded "the Best Paper Award by the Institute of Electrical Engineers of Japan".**

Debris-Free Laser-Assisted Low-Stress Dicing for Multi-Layered MEMS - Separation Method of Glass Layer -, IEEJ Transactions on Sensors and Micromachines, 128, 3 (2008) pp. 91-96

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We have investigated the novel debris-free in-air laser dicing technology for glass. The target wafer was a soda lime glass and a Pyrex glass with the thickness of 1mm. Our technology combines two processes, which was a dicing guide fabrication and a wafer separation process. First process was an internal transformation using a fundamental wavelength of a Ti-Sapphire laser or a Nd-YAG laser. The pulse width of each laser was 100fs and 10ns, The threshold energy for the internal transformation (NA-0.7 focusing) was  $3\mu\text{J}$  and  $65\mu\text{J}$ , respectively. The second process was a thermally-induced crack propagation using  $\text{CO}_2$  laser or a mechanical bending separation by pressing a blade. The internal transformation fabricated in first process worked sufficiently as the guide of separation, the dicing line completely followed the internal transformation. The diced cross-section was sharp and free chipping. In addition, neither debris nor damages were found on the surface after laser dicing.