Reliability of industrial packaging for microsystems

Packaging concepts for silicon-based micromachined sensors exposed to harsh environments are explored. By exposing the sensors directly to the media and applying protection at the wafer level the packaging and assembly will be simplified as compared to conventional methods of fabrication. Protective coatings of amorphous silicon carbide and tantalum oxide are suitable candidates with etch rates below 0.1 Ångstrom/h in aqueous solutions with pH II at temperatures up to 140 degrees C. Si-Ta-N films exhibit etch rates around 1 Ångstrom/h. Parylene C coatings did not etch but peeled off after extended exposure times at elevated temperatures. The best diamond-like carbon films we tested did not etch, but delaminated due to local penetration of the etchants. Several glue types were investigated for chip mounting of the sensors. Hard epoxies, such as Epo-tek H77, on the one hand exhibit high bond strength and least degradation and leakage, but on the other hand introduce large sensor output drift with temperature changes. Softening of the Epo-tek H77 was observed at 70 degrees C. An industrially attractive thin-film anodic silicon-to-silicon wafer bonding process was developed. Glass layers are deposited at 20 nm/s (1.2 μm/min) by electron-beam evaporation and bond strengths in excess of 25 N/mm(2) are obtained for bonding temperatures higher than 300 degrees C. Through-hole electrical feedthroughs with a minimum line width of 20 μm and a density of 250 wires per cm were obtained by applying electro-depositable photo-resist. Hermetically sealed feedthroughs were obtained using glass frits, which withstand pressures of 4000 bar. (C) 1998 Elsevier Science Ltd. All rights reserved.

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