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Strength Evaluation of Field-Assisted Bond Seals between Silicon and Pyrex Glass

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Three-point bend testing (in-situ in a SEM) of small beams, accomodating FAB microseals, was performed. The fracture limits obtained were much higher than previously reported: 220 ± 70 MPa. By fractographic investigation it was possible to determine where, why and how the fractures were initiated and subsequently propagated. The main cause was circular nonbonded regions caused by micron-sized dust particles in the FAB interface. The experimental fracture limits were found to agree with theoretical considerations, and it was concluded that practical fracture limits could be even further improved by careful elimination of dust particles during bonding.

1. Background

Field-assisted bonding (FAB) is a sealing technique with the general application of joining metals (bulk or foil), alloys and semiconductors to glass and certain ceramics.[1] FAB features low temperature processing (200–600°C) and produces strong, hermetic seals. The technique is currently being investigated,[2-5] but the mechanism behind the seal formation is not yet fully understood.

The technique has been applied in the solar cell industry[6] and, for the past few years, it has been extensively used in the silicon sensor industry.[7] FAB has several potential applications. Recently it was reported[8] that FAB of Si to glass can successfully be used to produce SOI-MOS structures for LCD applications. Multilayer structures of Si with glass interlayers, and Si microcavities can be fabricated with