SEALING OF CAVITIES WITH LATERAL FEED-THROUGHS BY ANODIC BONDING.

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The SESiBon[1)] project under the EU Growth programme has focussed on the investigation and exploitation of various silicon bonding techniques. Here we present the results of the work done to enable bonding of structured wafer surfaces, allowing lateral feed-throughs into sealed cavities. Both standard silicon to pyrex wafer bonding and the more advanced silicon-to-silicon thin film anodic bonding has been investigated.

Lateral feed throughs are formed by means of RIE in a high-doped poly-silicon film deposited on an oxidized 4" silicon wafer. Next a BPSG (Boron Phosphorus Silicate Glass) layer is deposited in a PECVD reaction chamber onto the structured surface. The BPSG is used as an intermediate planarization layer. Planarization is done by annealing the wafer in a N2-O2 ambient for 1 – 4 h @ 800 – 1000 ºC. After planarization and deposition of a thin-film sodium silicate glass the cavity wafer is bonded to the device wafer, sealing the cavities.

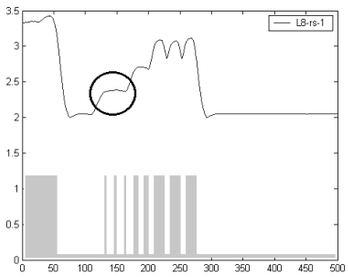

Figure 1 showing a surface scan of one of the test structures used to examine the BPSG properties. Inset in the bottom is a cross section of the surface, which has been coated with BPSG.

Planarization of structured wafers using BPSG has been studied by other groups [1]. At wafer level, however, planarization at wafer level is a demanding process strongly dependent of the properties of the float glass. In order to achieve a feasible design the mask layout for the sealed cavities must take these properties into account. Figure 1 shows a measurement performed on one of the test structures used to examine the BPSG properties. The inset in the bottom of the figure shows a cross section of the wafer, which has been coated with BPSG. The graph shows the BPSG surface profile post annealed. As can be seen the glass planarizes the more open structures better (encircled) than the more closed ones.

Our work with BPSG has proven that although it is not trivial, planarization of structured wafer surfaces to a flatness necessary for bonding is feasible. It is necessary to design the lateral feed-through structures in accordance with the BPSG floating properties allowing space for the glass to flow into the valleys of the surface. Furthermore the bonding plateau by necessity needs to be the highest level of the surface. When this requirement cannot be met it is necessary to create cavities in the opposite wafer.

[1] Darrell L. Simpson et al., Planarization Processes and Applications I. and II., Jour. Elec.Chem. Soc., Vol. 146 Issue 10 (1999)

1) SESiBon: Sensor Encapsulation by Silicon Bonding