Silicon-Based Flexible Electronics

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The combination of microelectronic process technologies with flexible substrates offers a variety of new applications such as smart cards, smart labels, or 3-dimensional integrated devices. Typical flexible materials such as polymers are only partially applicable to device processes. On the other hand, silicon wafers are flexible if they are thinned down to a few micrometers.

There are different concepts for the fabrication of thin isolated wafers or thin wafers bonded temporary or permanent on a non-flexible substrate. Thin isolated wafers are prepared mostly by mechanical thinning (grinding) followed by an final polishing step which can be realized by mechanical polishing (CMP), wet chemical polishing (etching), or by dry etching. Actually, the preparation of isolated wafers is possible up to thicknesses of about 30 µm. There are, however, numerous unresolved problems related especially to the handling, dicing, etc.).

Wafers bonded on non-flexible substrates during thinning are easy to handle. Thin wafers bonded permanent on a substrate are realized by known wafer bonding techniques. But their further application requires special treatments during the bonding process for additional preparation steps (trench etching, formation of thin membranes, etc.).

The temporary bonding of wafers is also frequently applied. The wafer is mounted on a substrate by a thin layer of wax. This technique implies numerous problems for large diameter wafers such as an increasing TTV value (total thickness variation), or the instability during thermal treatments. Therefore new concepts are necessary.

The present paper reviews the state of the art and further requirements for preparation techniques applicable for flexible electronics. Specific bonding techniques and thinning strategies are especially discussed.

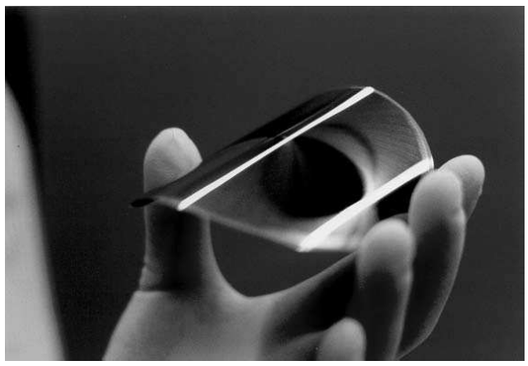

Figure 1: Example of a flexible wafer. The wafer thickness is 30 µm (diameter 4in.)