Hybrid Bonding as Crucial Technology for Future Applications

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Abstract:

Hybrid wafer-to-wafer bonding gained over the past decade a significant interest as it can provide major advantages in fabrication of wafer-level interconnects. The process is extremely challenging in terms of surface preparation, as substrates must accommodate two types of bonding processes simultaneously (dielectric-dielectric low temperature fusion bonding and Cu-Cu thermo-compression bonding localized at bonding pad level).

The fabrication of the bonding surfaces has to consider a specific topography (metal recess with respect to dielectric surface within single digit nanometers, dielectric surface with very low micro roughness - less than 0.5 nm, etc,) with very high uniformity across300 mm diameter wafers. The bonding process must ensure a high alignment accuracy (sub-micrometer) across the entire wafer and low temperature processing, within the COS thermal budget (<4009C). After the bonding process one of the two bonding partners has to be thinned down: in case the substrates preparation was not performed according to specifications or the bonding process was not properly performed, the structures on the wafer will be distorted, making further processing more difficult, time consuming and adding costs. Thus, substrates quality and accurate bonding process control are of a very high importance.

An overview of the main aspects related to hybrid bonding will be presented. The main specifications and some of the main challenges of this technology will be reviewed with respect to their impact on process results. The main challenges with respect to process equipment will be reviewed. The importance of new metrology and investigation methods adoption will be emphasized.