Hybrid and Fusion Bonding to Enable Advanced Packaging

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Direct bonding is emerging as a critical technology for advanced 3D architectures. Fusion bonding plays a pivotal role in enabling CFET and BSPDN structures in logic devices, as well as advanced 3D memory structures [1]. Similarly, hybrid bonding has become indispensable for meeting the stringent requirements of HBM, CIS, and 3D NAND development [2,3]. Despite its growing importance, the mechanisms underlying wafer bonding remain inadequately understood. Achieving ultimate distortion control is critical for precise overlay corrections during lithography. Bond wave behavior, the primary contributor to wafer bonding distortion, remains insufficiently explored. Plasma activation and surface wetting are thought to strongly influence bond wave speed, yet their surface-level interactions are poorly understood [4] (Fig. (a)). Furthermore, the lack of standardized bond strength measurement methods introduces significant variability in results [5] (Fig. (b)). In this paper, we will share our latest findings on the comprehensive study of wafer/die bonding mechanisms. These insights aim to support the evolution of future node 3D architectures.

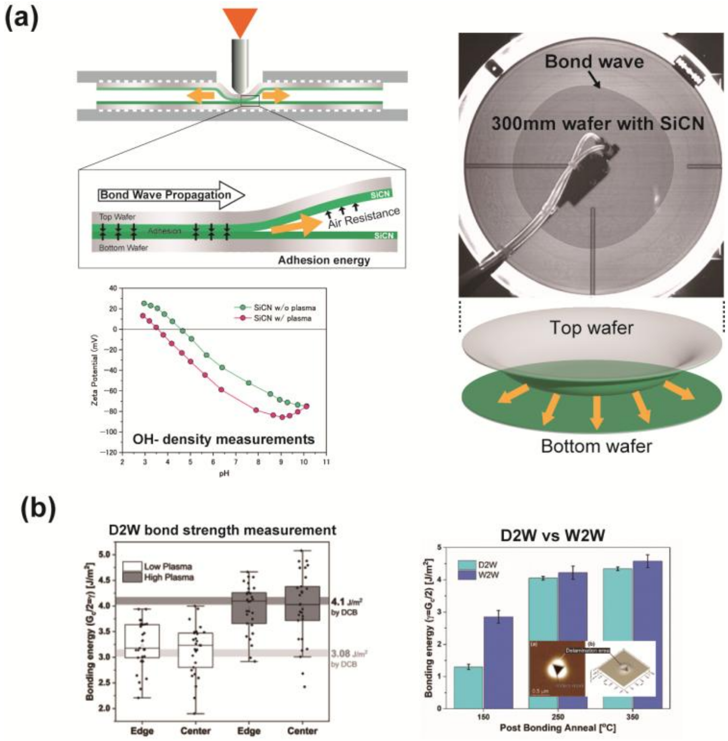

Figure (a) Bond wave analysis for ultimate distortion control in 300 mm wafer with SiCN (b) Bond strength measurements for die level hybrid bonding.

References

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