

智慧型記憶體及晶片系統實驗室

鑽石計畫維基夥伴獎學金第一學期成果簡報

三維積體電路技術：混和接合矽晶直通孔之電性研究 Electrical Characterization of Cu TSVs and Cu/Sn-BCB Hybrid Bonding

Abstract:

1. A wafer-level 3D integration structure with Cu TSVs based on Cu/Sn micro-bumps and BCB hybrid bonding is demonstrated.
2. Kelvin structure and daisy chain design are adopted for electrical characterization and reliability evaluation.
3. Therefore, leakage measurement is used to examine the process flow.
4. To sum up, The results indicate the developed 3D integration scheme has excellent reliability and electrical stability and express that the successful demonstration provides a good option for future 3D integration applications.

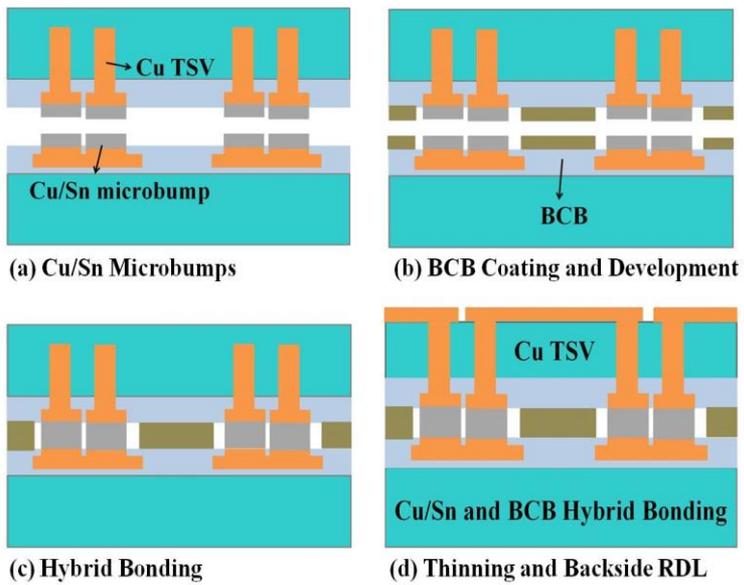
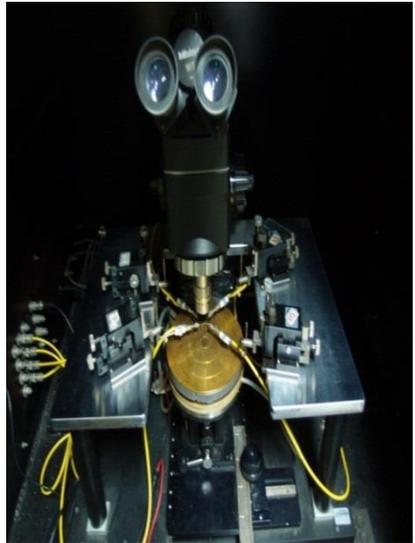
Experimental :

4156C 精準半導體參數分析儀

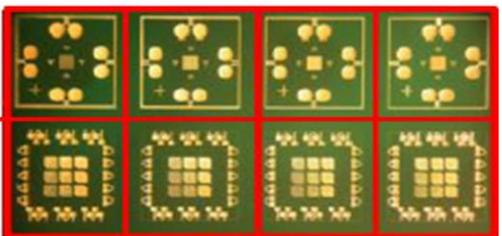
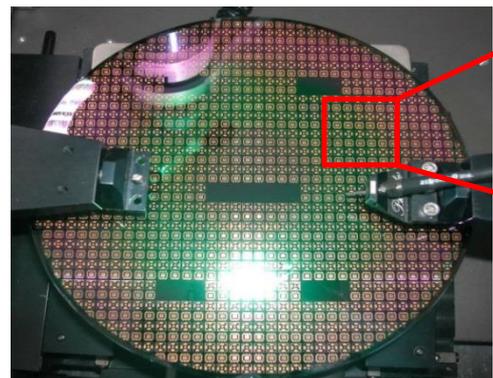
4284A 精密型 LCR 錶



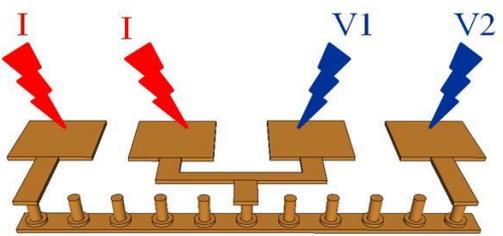
Four-Point Probe Station



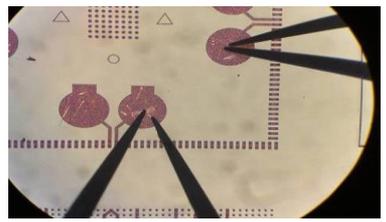
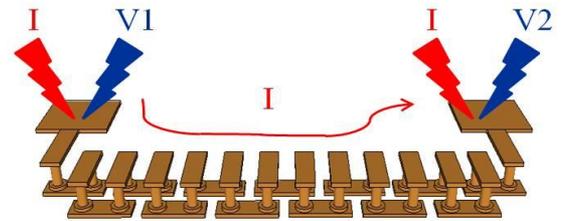
The structure design and schematic process flow of 3D integration structure.

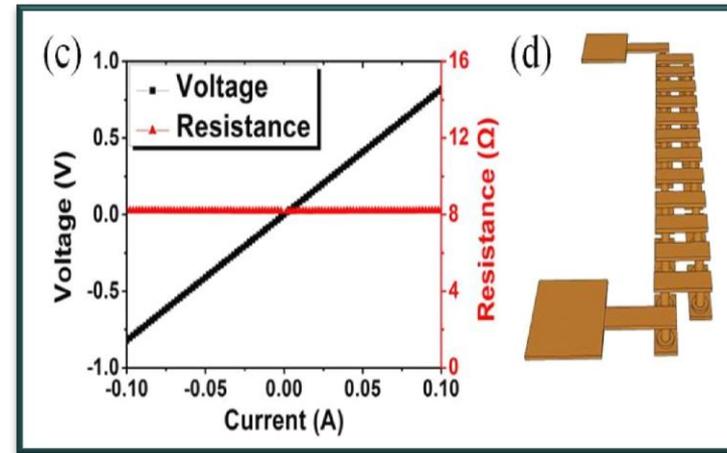
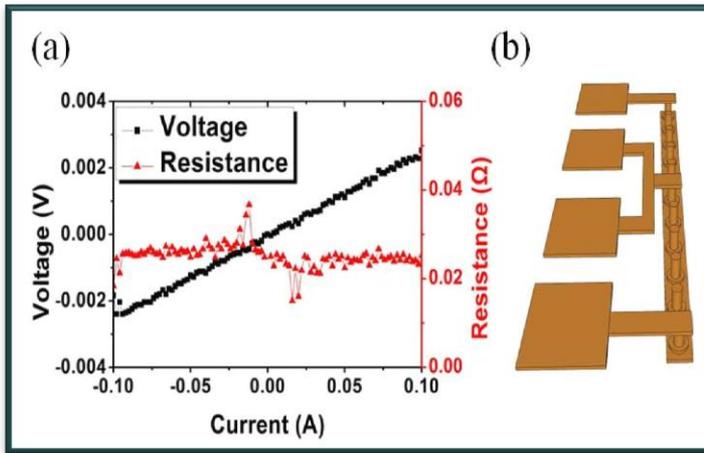


Kelvin Design



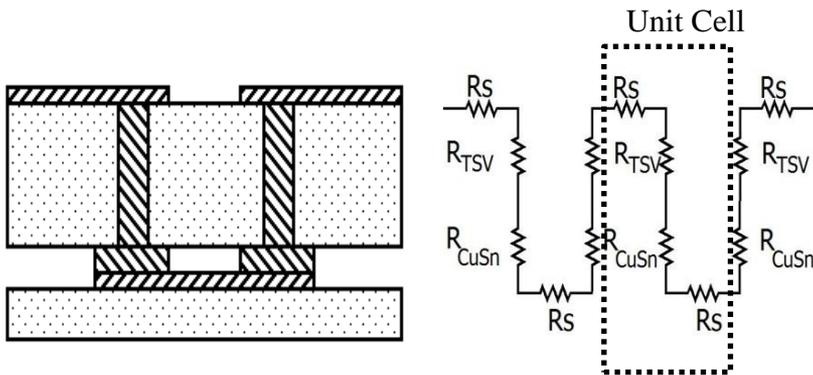
Daisy Design





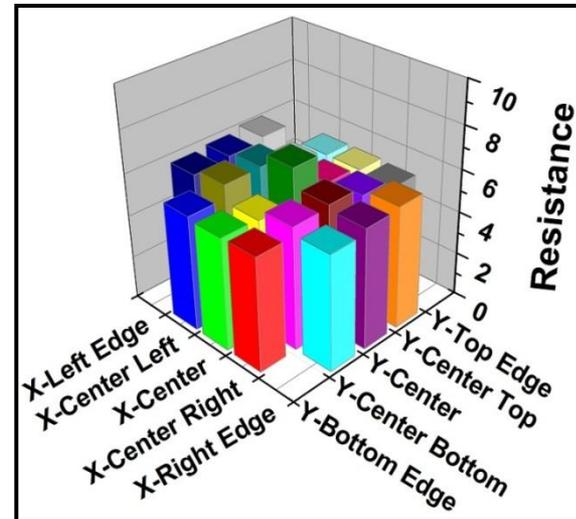
(a) V-I and R-I curves
 (b) schematic diagram of Kelvin structure design

(c) V-I and R-I curves
 (d) schematic diagram of daisy chain design with N=200 via chains.

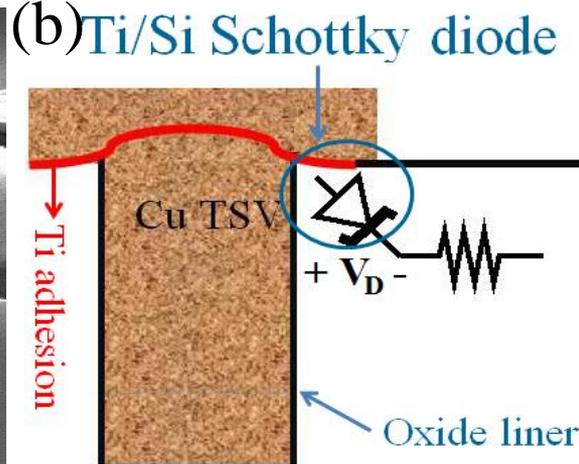
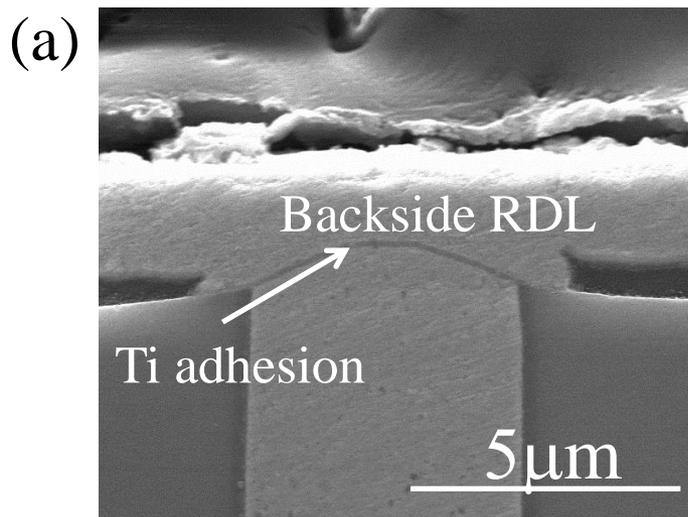


$$R_{Kelvin} = R_{10\mu m TSV} + R_{CuSn microbump} \quad (1)$$

$$R_{Daisy chain} = N \cdot (R_{Cu TSV} + R_{CuSn microbump} + R_S) \quad (2)$$



Characteristics of total resistances of N=100 via chains and locations on wafer.

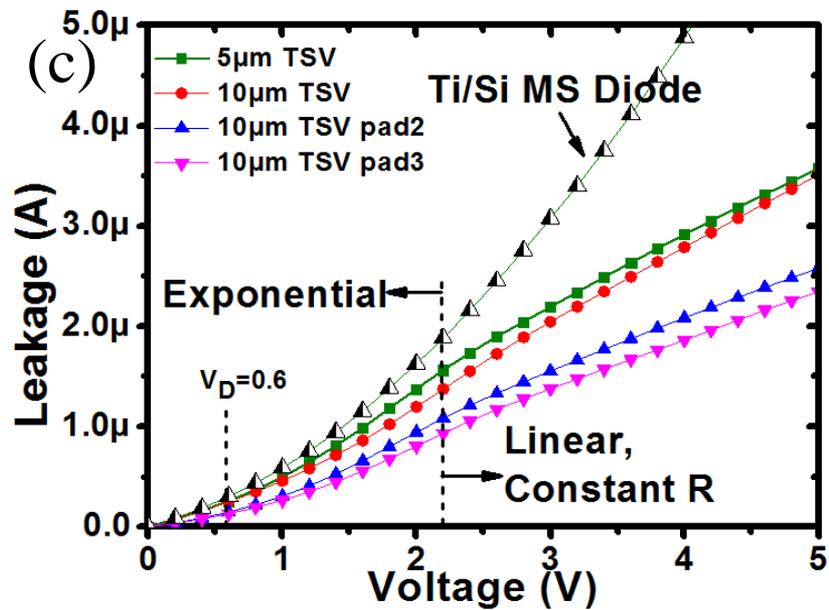


(a) SEM image to observe the leakage's location

(b) Schematic diagram for analysing the characteristic

(c) I(leakage)-V Curve

(d) OBIRCH image



1. Cu TSVs with wafer-level Cu/Sn micro-bumps and BCB hybrid bonding scheme was demonstrated. Therefore the Cu/Sn micro-bumps and BCB hybrid bonding has the low bonding temperature and strong bonding intensity.
2. Kelvin structure and Daisy are design used for measuring the resistance, obviously indicate that these batch of chip have high qualities and stable electrical characteristic and good reliability.
3. The result of leakage measurement not only express the impact of many effect but also give the way to improve the consideration in process. All in all, the Cu/Sn –BCB hybrid bonding are verified the superior feature and speculated that this wafer-level bonding will offer good reference in future 3D integration applications.