

# Spherolyte<sup>®</sup> Cu DB

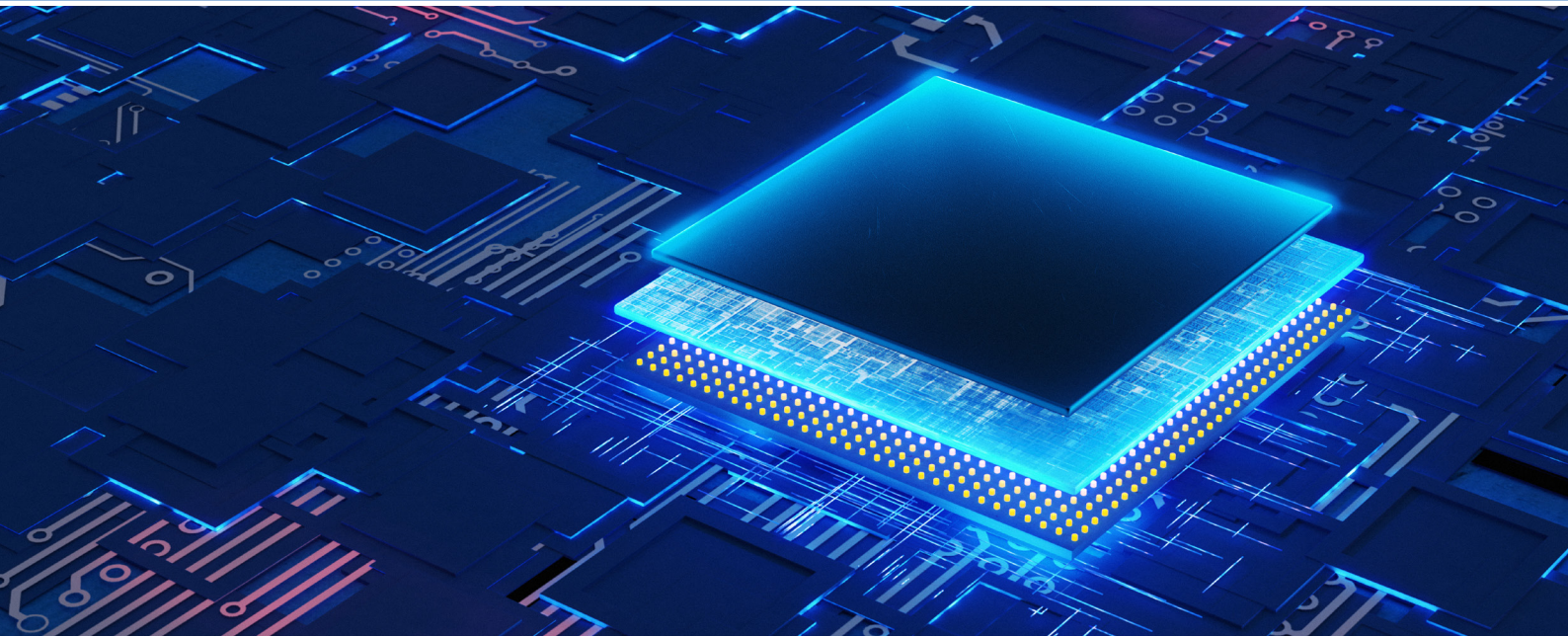
Next generation Cu-to-Cu direct bonding



Electronics

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## Low temperature annealing Cu for next generation bonding

### Copper direct bonding for advanced packaging

Cu-to-Cu direct bonding promises to be one of the key technologies for the manufacturing of next generation semiconductor devices. It allows enhanced device performance due to superior electrical performance and simultaneous smaller form factors and higher reliabilities. Additionally, wafer-to-wafer bonding enables cost advantages and improved production efficiencies.

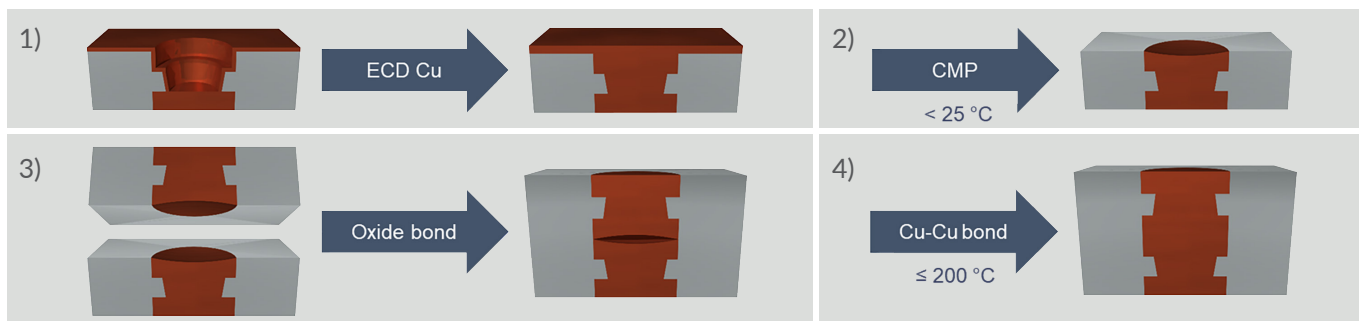
Spherolyte<sup>®</sup> Cu DB meets the requirements of next generation Cu-to-Cu bonding, for which relatively low bonding temperatures  $\leq 200$  °C are required.

### Features and benefits

- Bond formations at low temperatures ( $\leq 200$  °C)
- Deposition of pure copper
- Superior via filling capabilities
- High uniformity
- Good ductility
- Good electromigration performance

# Next generation Cu-to-Cu direct bonding

## Cu-to-Cu direct bonding sequence based on metastable Cu



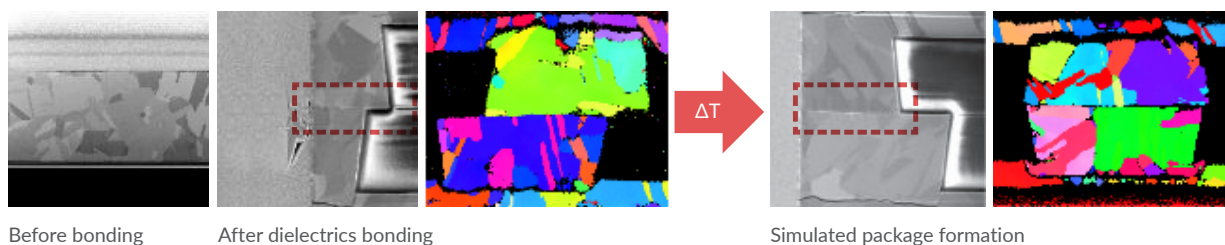
1) Filling of vias with electrolytic metastable Cu; 2) chemical mechanical polishing to remove Cu cover layer; 3) Preliminary dielectrics bonding; 4) annealing step at temperatures  $\leq 200$  °C to allow Cu-to-Cu bond formation over interface.

## Bondformation by metastable copper

Spherolyte® Cu DB is our new process for the deposition of metastable Cu, which allows to execute Cu-to-Cu direct bonding at low temperatures.

Standard processes deposit coarse grained Cu which under low-temperatures does not change its structures and hence requires higher bonding temperatures. Spherolyte® Cu DB deposits pure, metastable Cu which recrystallizes at temperatures  $\leq 200$  °C, leading to a grain growth of the Cu interface and hence a firm bonding step.

### Non-optimized process (stable, coarse-grained microstructure)



### Optimized process (metastable microstructure)

