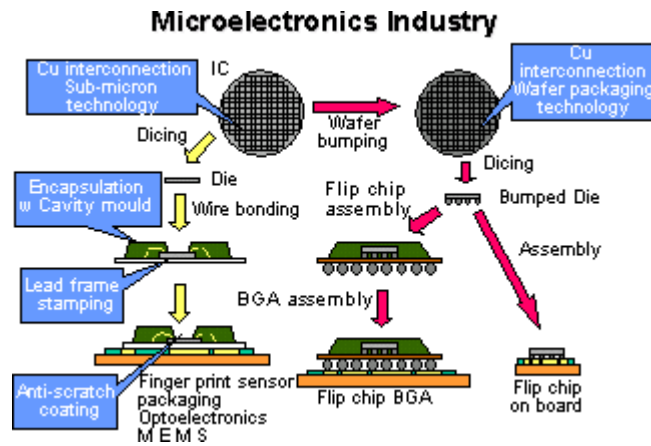


Microelectronics

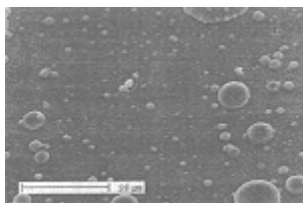
Copper Technology



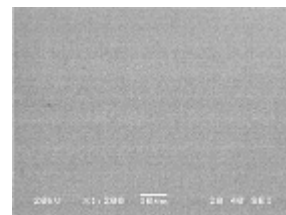
The industry for semiconductor devices has relied on aluminum for internal interconnect structures exclusively for over 30 years. But in the quest for smaller, faster semiconductors, aluminium is proving to be increasingly problematic since it resists the flow of electricity as wires are made ever thinner and narrower.

Copper will likely become the metal of choice for microprocessor circuits as chips get smaller and faster. Copper is much more conductive than aluminum, allowing finer wires with lower resistive losses. Copper is also significantly less vulnerable to electromigration than aluminum and less likely to fracture under stress. Copper interconnects therefore allow the chip size to be reduced while speed and complexity is increased.

However, copper readily diffuses into silicon and causes deep-level defects. To keep the copper from migrating into the dielectric and poisoning it, a diffusion barrier is used, which lines the trench walls between the copper and the substrate. Titanium nitride and Tantalum nitride are some of the possible barrier materials used to prevent the contamination of copper in silicon or silicon dioxide and simultaneously improve the adhesion between the copper and substrate.



Copper Film Deposited with an Industrial DC Arc



Clean Copper Film by FCVA Technique

Al metallization is phasing out

- High resistivity: $2.65 \times 10^{-6} \Omega\text{cm}$
- Electromigration

Copper metallization is phasing in

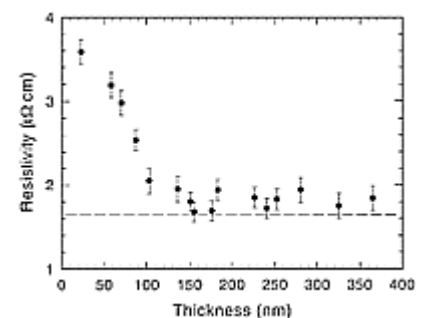
- Lower Resistivity compared to Al
 - $1.67 \times 10^{-6} \Omega\text{cm}$ vs. $2.65 \times 10^{-6} \Omega\text{cm}$
 - Allows finer lines and lower RC delays
- Higher Mass and Higher Melting Point
 - Less susceptible to electromigration
- High diffusion

Need barrier layer - Ta(N), Ti(N)

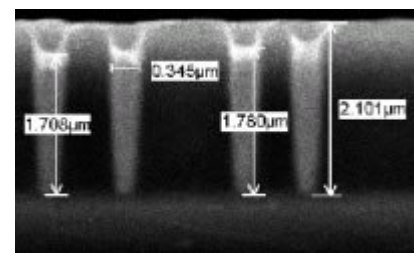
Advantages of FCVA Tech.

The innovative FCVA technique can be used to deposit fully conformal diffusion barriers of Ta and TaN as well as Cu seeding layers in trenches and vias. With the FCVA technique, the fully ionized metal plasma stream, consisting of ions of the cathode material and electrons, are steered through a magnetic filter stream towards the substrate. By applying a variable bias to the substrate, the energy of the ions can be controlled in the range from dozens to thousands of electron volts.

- Cu Resistivity Obtained Close to Bulk Material



- FCVA technique can deposit thinner, more uniform layers of metals in a variety of architectures.
- It can be used in narrower trenches with higher depth-to-width aspect ratios.
- It can fill trenches from bottom up, thus eliminating uneven deposition which can lead to voids in the metal lines.

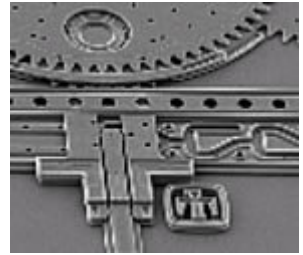


Cu filling

(by Nanofilm's FCVA Tech.)

Instances

- Protective coating micromachining part



MEMS

- Cavity mould

- Protective coating of fingerprint sensor



Fingerprint Sensor