

Requirements for Chip Metallization

The metal lines connecting transistors or other components on a **Si** chip must meet many, partially conflicting, requirements. Below is a list, including some materials that do *not* meet the particular requirement very well.

Can you guess the winner?

Advanced

Desired Property	Materials not meeting requirement
Very good conductivity	All but Ag, Cu
High eutectic temperature with Si (> 800 °C would be good)	Au, Pd, Al, Mg
Low diffusivity in Si	Cu, Ni, Li
Low oxidation rate; stable oxide	Refr. Metals, Mg, Fe, Cu, Ag
High melting point	Al, Mg, Cu
Minimal interaction with Si substrate	Pt, Pd, Rh, V, Ni, Mo, Cr (form silicides easily)
Minimal interaction with poly Si	Same as above
No interaction with SiO₂	Hf, Zr, Ti, Ta, Nb, V, Mg, Al
But must stick well to SiO₂	?
Must also comply with other substrates, e.g. TiN	? (see example for Al)
Chemical stability, especially in HF environments	Fe, Co, Ni, Cu, Mg, Al
Easy structuring	Pt, Pd, Ni, Co, Au
Electromigration resistant	Al, Cu
.... and many more,...	

The winner is: **Aluminum** (with **<1%** of **Si** and **Cu** added).

Al, in fact, is pretty bad - but all others are worse!

Presently (**2001**) a switch to **Cu** takes place (the better conductivity is definitely needed). The industry will pay several **10⁹** Dollars to develop the new material technology and change the production facilities.