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?

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 SiO ₂	Hf, Zr, Ti, Ta, Nb, V. Mg, Al
But must stick well to SiO ₂	?
Must also comply with other substrates, e.g. TiN	? (see example for AI)
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).
 - AI, 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.