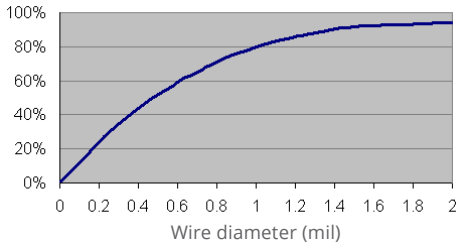
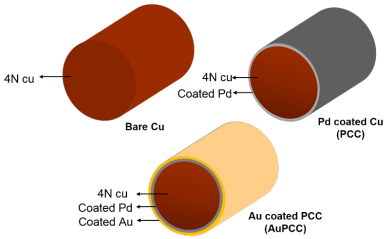
Copper Wirebonding

Cu wire offers significant cost advantage over Au wire. It is also an excellent replacement for Au wire due to its similar electrical properties. Self-inductance and self-capacitance are nearly the same for Au and Cu wire and Cu wire has lower resistivity. In applications where resistance due to bond wire can negatively impact circuit performance, using Cu wire can offer improvement.

Wire Material Cost Savings Cu Versus Au





Cu-Alloy Wire Readiness

Package Family	Cu Wire HVM Plant
CABGA	C3, K4, P3, ATJ
fcCSP	C3
LQFP	P1, ATJ
*Micro*LeadFrame® (QFN)	C3, P1, P3
MQFP	P1, T1
PBGA	K4, P3
PDIP, PLCC	P1
Package-on-Package (PoP)	K4
PSOP	P1
SBGA	K4
SC70	P1
SCSP	C3, K4, ATJ
System in Package (SiP)	K4
SOIC	P1
SO8-FL	M1
SOT-23	P1
SSOP	P1
TQFP	P1, ATJ
TSSOP	P1
TSON, TOLL	M1

COPPER WIRE BENEFITS

Cu wire has long been used as a method of connecting a silicon die to the package terminals. With the recent increase in gold (Au) wire cost, Cu wire is an attractive way to manage overall package cost.

- Increasing cost of Au is driving the need to use lower cost Cu wire
- Copper is an attractive replacement material for Au because of good electrical & thermal performance
- Amkor has a long & wide history of Cu wire process
  - 20+ years of experience (development to HVM)
  - Qualified on 0.6-2.0 mils diameter Cu wire
  - Under development: >2.0 mils diameter Cu wire
- Mass production on both leadframe & laminate products
- Cu wire is supported in all Amkor worldwide factories with mass production since 2006
- Amkor worldwide Cu wire BOM/BKMs established

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Copper Wirebonding

Wire Dia (µm)	Current Carrying Capacity (Amps)				3D Electrical Parasitic Parameters					
	Wire Length >40 mil (1 mm)				Wire Length = 40 mil (1 mm)					
	Wire Type				R11 (mΩ) @ 1 GHz		C11 (pF)		L11 (nH)	
	Au Wire (4-9's)	Au Wire (3-9's)	Au Wire (2-9's)	Cu Wire (4-9's)	Au Wire	Cu Wire	Au Wire	Cu Wire	Au Wire	Cu Wire
51	1.83	1.81	1.61	1.83	73.9	62.2	0.119	0.119	0.515	0.515
25	0.63	0.62	0.55	0.63	144.4	116	0.081	0.081	0.69	0.677
23	0.56	0.55	0.49	0.56	154.1	128.7	0.078	0.078	0.707	0.687
20	0.45	0.45	0.4	0.45	172.9	145	0.075	0.075	0.728	0.724
18	0.39	0.38	0.34	0.39	196.3	163.2	0.071	0.071	0.76	0.751
15	0.29	0.29	0.26	0.29	234.3	194.7	0.067	0.067	0.811	0.801
Resistivity (µohm-cm)	2.3	2.5	3	1.7						

Minimum Bond Pad Size by Wire Diameter (T = Bond Pad Metal Thickness)

		0.7 ≤ T ≤ 1.5 µm				1.5 ≤ T ≤ 2.5 µm				2.6 ≤ T ≤ 4.0 µm			
		FWD		SSB		FWD		SSB		FWD		SSB	
		BPO	BPP	BPO	BPP	BPO	BPP	BPO	BPP	BPO	BPP	BPO	BPP
Recommended Wire	15 µm	≥40	≥48	≥42	≥50	≥42	≥50	≥44	≥52	≥44	≥52	≥46	≥54
	18 µm	≥45	≥53	≥47	≥55	≥47	≥55	≥49	≥57	≥49	≥57	≥51	≥59
	20 µm	≥50	≥58	≥52	≥60	≥52	≥60	≥54	≥62	≥54	≥62	≥56	≥64
	23 µm	≥58	≥66	≥60	≥68	≥60	≥68	≥62	≥70	≥62	≥70	≥64	≥72
	25 µm	≥62	≥70	≥64	≥72	≥64	≥72	≥66	≥74	≥66	≥74	≥68	≥76
	30 µm	≥79	≥87	≥81	≥89	≥81	≥89	≥83	≥91	≥83	≥91	≥85	≥93
	33 µm	≥85	≥93	≥87	≥95	≥87	≥95	≥89	≥97	≥89	≥97	≥91	≥99
	38 µm	≥105	≥113	≥107	≥115	≥107	≥115	≥109	≥117	≥109	≥117	≥111	≥119
	51 µm	≥150	≥158	≥152	≥160	≥152	≥160	≥154	≥162	≥154	≥162	≥156	≥164

Minimum Bond Pad Size by Wire Diameter (T = Bond Pad Metal Thickness)

	>60 nm	55/60 nm	45/40 nm	28 nm	<28 nm
Non-Low-k Or Low-k	Low-k	Low-k	Ultra Low-k	Ultra Low-k	Ultra Low-k
Reliability Status	Customer Qualified	Customer Qualified	Customer Qualified	Customer Qualified	In Process
Production Status	HVM	HVM	HVM	HVM	Development

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