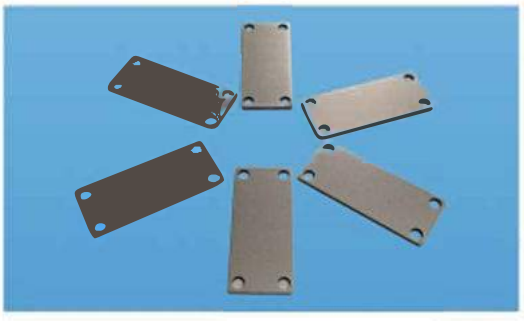
# Heat Spreader Materials---Tungsten Copper

Tungsten copper (WCu) is a composite of tungsten and copper, so both the thermal conductivity advantage of copper and the very low thermal expansion characteristic of tungsten can be utilized. By adjusting the content of tungsten, it is possible to have appropriate thermal expansion to match with those of silicone (Si), aluminum oxide (Al2O3), and beryllium oxide (BeO), etc.

| Grade | W Content | Density g/cm³ | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|---|
| 90WCu | 90±2% | 17.0 | 6.5 | 180 (25℃) /176 (100℃) |
| 85WCu | 85±2% | 16.4 | 7.2 | 190 (25℃) / 183 (100℃) |
| 80WCu | 80±2% | 15.65 | 8.3 | 200 (25℃) / 197 (100℃) |
| 75WCu | 75±2% | 14.9 | 9.0 | 230 (25℃) / 220 (100℃) |
| 50WCu | 50±2% | 12.2 | 12.5 | 340 (25℃) / 310 (100℃) |



Tungsten copper heat sinks are extensively used as thermal mounting plates, chip carriers, flanges and frames for RF and microwave packages, laser diode packages and complex carriers for optoelectronics amplifiers, receivers, transmitters, tunable lasers, etc.



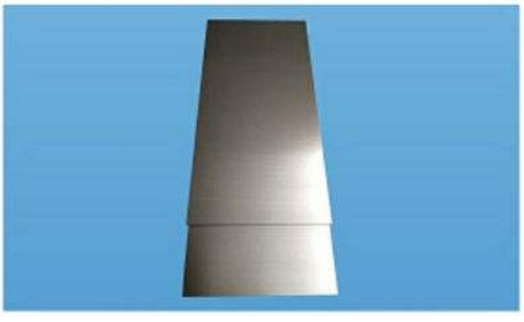
## Heat Spreader Materials---Molybdenum Copper

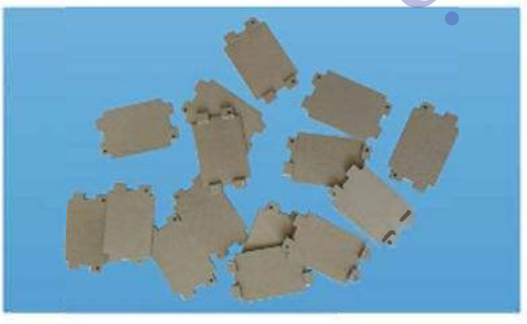
Molybdenum copper (MoCu) is a composite material of molybdenum and copper which has adjustable thermal expansion coefficient and thermal conductivity. It has lower density yet higher CTE compared with copper tungsten. Therefore, molybdenum copper alloy is more suitable for aerospace and other fields.

| Grade | Mo Content | Density g/cm³ | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|---|
| 85MoCu | 85±2% | 10.01 | 7 | 160 (25℃)/156(100℃) |
| 80MoCu | 80±2% | 9.9 | 7 | 190(25℃)/170(100℃) |
| 70MoCu | 70±2% | 9.8 | 7.3 | 200(25℃)/196(100℃) |
| 60MoCu | 60±2% | 9.6 | 8.4 | 222(25℃)/217(100℃) |
| 50MoCu | 50±2% | 9.54 | 11.5 | 270(25℃)/230(100℃) |



Molybdenum copper heat sinks are widely used in applications such as microwave carriers, ceramic substrate carriers, laser diode mounts, optical packages, power packages, butterfly packages and crystal carriers for solid state lasers, etc.





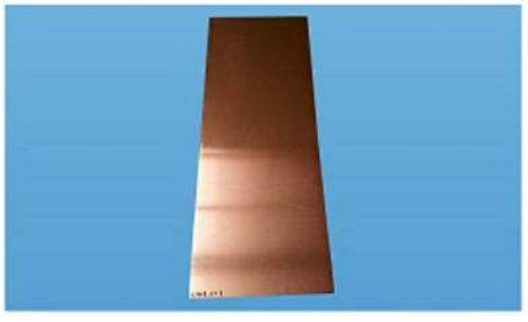
## Heat Spreader Materials---Copper Molybdenum Copper

Copper molybdenum copper (Cu/Mo/Cu) is a sandwich structured and flat-panel composite material. It uses pure molybdenum as the core material, and two copper clad layers. Besides, copper molybdenum copper alloy has adjustable coefficient of thermal expansion, high thermal conductivity, and high thermal stability.

| Grade | Density g/cm³ | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|
| CMC111 | 9.32 | 8.8 | 305 (XY)/250 (Z) |
| CMC121 | 9.54 | 7.8 | 260 (XY)/210 (Z) |
| CMC131 | 9.66 | 7 | 244 (XY)/190 (Z) |
| CMC141 | 9.75 | 6 | 220 (XY)/180 (Z) |
| CMC13/74/13 | 9.88 | 5.6 | 200 (XY)/170 (Z) |



Cu/Mo/Cu (CMC) heat sinks have similar applications with tungsten copper heat sinks. It can be used as thermal mounting plates, chip carriers for microwave components, flanges and frames for RF and laser diode packages, LED packages, BGA packages and GaAs device mounts etc.



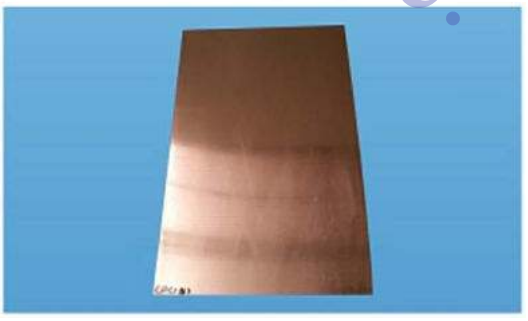
## Heat Spreader Materials---Copper Molybdenum Copper Copper

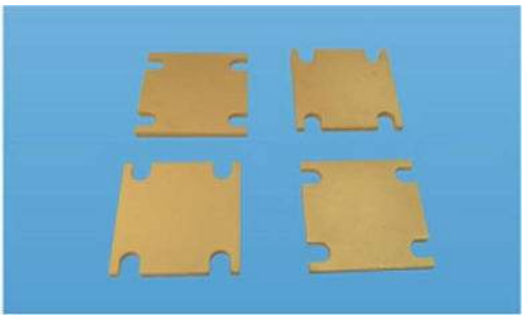
Copper molybdenum copper copper (Cu/MoCu/Cu) is a sandwich composite like Cu/Mo/Cu including a Mo-Cu alloy core layer and two copper clad layers.The ratio of the thickness in Cu:Mo-Cu:Cu can be varied. It has higher thermal conductivity than that of W(Mo)-Cu and Cu/Mo/Cu.

| Grade | Density g/cm³ | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|
| CPC141 | 9.5 | 7.3 | 220 (25℃)/211(100℃) |
| CPC232 | 9.3 | 7.5 | 255 (25℃)/250(100℃) |
| CPC111 | 9.2 | 9.5 | 260 (25℃) |



Cu/MoCu/Cu (CPC) heat sinks can be used as thermal mounting plates, chip carriers for microwave components, flanges and frames for RF and laser diode packages, LED packages, BGA packages and GaAs device mounts etc.





## Heat Spreader Materials---S-CMC

S-CMC is a multi-layered copper and molybdenum clad metal, which has an excellent properties with both low CTE and high thermal conductivity. Its higher thermal conductivity compared to other kinds of materials contributes to highly powered electronic packages.

| Material | Mo Content | g/cm³ Density | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|---|
| S-CMC | 5 | 9.0 | 14.8 | 362 |
| | 10 | 9.0 | 11.8 | 335 |
| | 13.3 | 9.1 | 10.9 | 320 |
| | 20 | 9.2 | 7.4 | 291 |



S-CMC heat sinks can be used in wireless communication packages, optoelectronics packages etc.

## Heat Spreader Materials---Copper

Oxygen-free copper (OFC) with typical oxygen content below 0.001% is excellent in electrical and thermal conductivity, spreadability and drawing. It has no hydrogen embrittlement even when being heated to high temperature in a reducing atmosphere.

CuFe1P with a nominal copper content of 99.9% has a small amount of iron and phosphorus in chemical compositions. It is hardened by Fe2P which precipitates in copper matrix. High performance copper alloy with relatively high strength and electrical conductivity has good heat resistance, and workability.



| Grade | Density g/cm³ | Coefficient of thermal expansion ×10⁻⁶(20℃) | Thermal conductivity W/(M·K) |
|---|---|---|---|
| OFC | 8.93 | 17.7 | 391 |
| CuFe1P | 8.86-8.92 | 17 | 350 |

OFC and CuFe1P can be used as microwave carriers and heat sinks, BGA Packages, LED packages, GaAs device mounts.