# CuAg12

**UNS:-**
**EN:-**

It is necessary to create a unique combination of material properties for the construction of the magnets produced super high magnetic fields. The conductor materials for the production of magnetic windings must have high mechanical strength and good electrical conductivity in order to minimize Joule heating and endure Lorentz force caused by large electrical currents in the windings during operation. The characteristics of high strength and conductivity are also required for the materials used in the manufacture of lead wire frames in large-scale integrated circuits and power transmission system to high-speed electric locomotives. Cu-Ag alloys have further been expected in the application of high-field magnet design due to their better electrical and mechanical properties than other conductor alloys. In the micro composite wires, both combination of the work hardening and filamentary reinforcing produces significant strengthening benefit. Optimal processes of intermediate heat treatments introduced in cold formation further improve the strength and conductivity. [Ref: 80]

## Basic properties

| Basic properties | Value | Comments | Literature |
|---|---|---|---|
| Density [g/cm$^3$] | 9,1 | Copper based alloy, CuAg10 | [Ref: 661] |
| Specific heat capacity [J/(kg*K)] | No data | | |
| Temperature coefficient of electrical resistance (0...100°C) [$10^{-3}$/K] | 0,00255 | Copper based alloy, CuAg10 | [Ref: 661] |
| Electrical conductivity [T=20°C, (% IACS)] | 70-80 | Soft - Hard, Copper based alloy, CuAg10 | [Ref: 661] |
| Thermal conductivity [W/(m*K)] | No data | | |
| Thermal expansion coefficient 20...300°C [$10^{-6}$/K] | No data | | |

# Applications

## Main applications

Conductor materials in pulsed high-field magnets, sheet-conductor, power, signal, diagnostic cables, windings, supply cables, transformers, sheet metal, wires, microwires. Literature: [Ref: 72, 75, 77, 78, 79, 80]

Materials used in the manufacture of lead wire frames in large-scale integrated circuits and power transmission system to high-speed electric locomotives [Ref: 80]

## Kinds of semi-finished products/final products

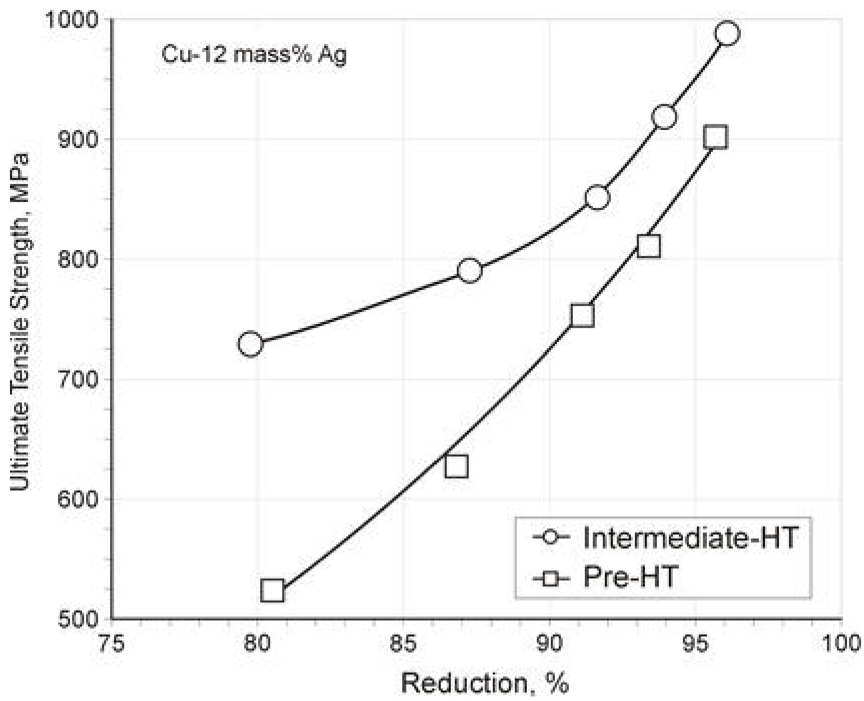
NO DATA AVAILABLE

## Chemical composition

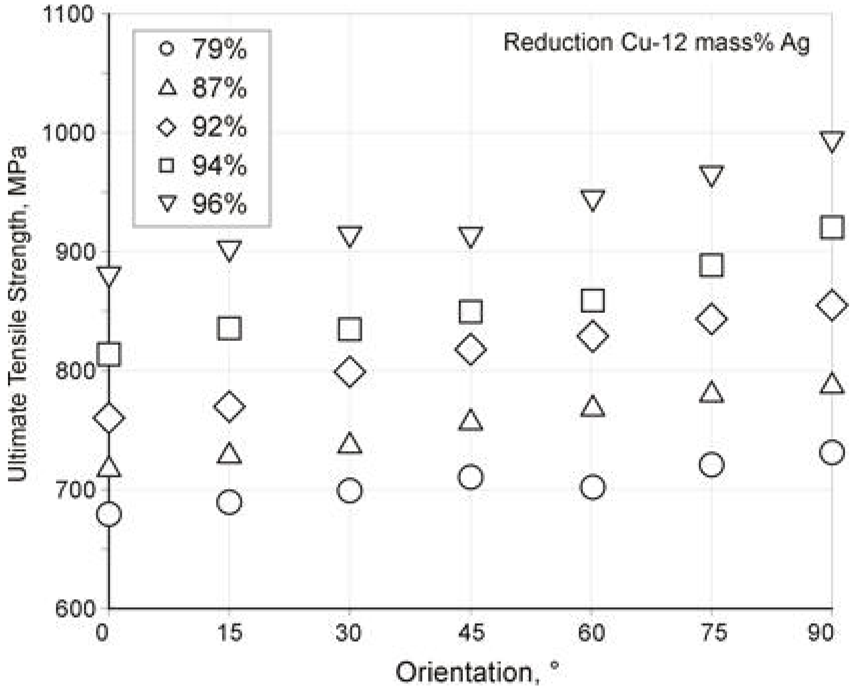
| Chemical composition | Value | Comments | Literature |
|---|---|---|---|
| Ag [wt.%] | 12 | approximate value | |
| Cu [wt.%] | 88 | approximate value | |

## Mechanical properties

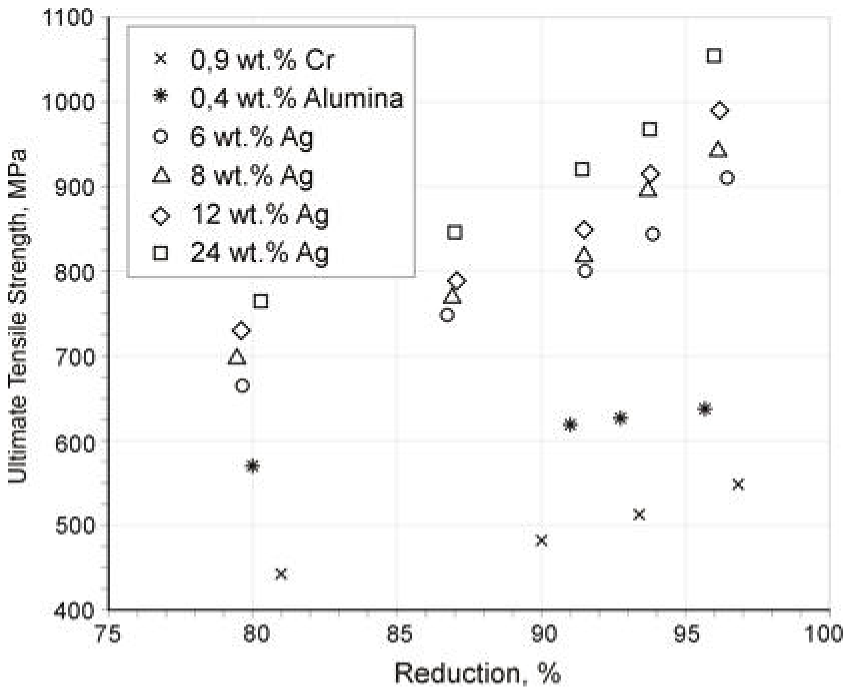
| Mechanical properties | Value | Comments | Literature |
|---|---|---|---|
| UTS [MPa] | 300-750 | Soft - Hard, Copper based alloy, CuAg10 | [Ref: 661] |
| YS [MPa] | No data | | |
| Elongation [%] | 1-30 | Soft - Hard, Copper based alloy, CuAg10 | [Ref: 661] |
| Hardness | No data | | |
| Young's modulus [GPa] | No data | | |
| Kirchhoff's modulus [GPa] | No data | | |
| Poisson ratio | No data | | |



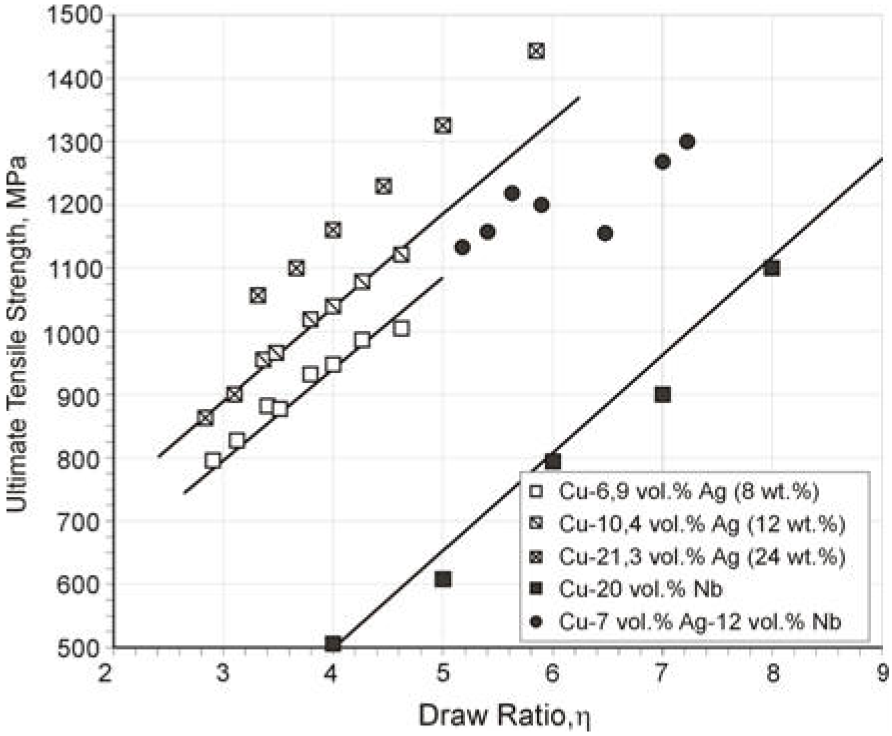

*Tensile strength of Cu-12 mass% Ag alloy sheets with and without intermediate heat treatment as a function of reduction ratio.*
*(a) without intermediate heat treatment, (b) with intermediate heat treatments at 450* °C for at a reduction of 10% then at 450°C for 1 h at 30% and finally at 400°C for 1 h at 60% [Ref: 72]



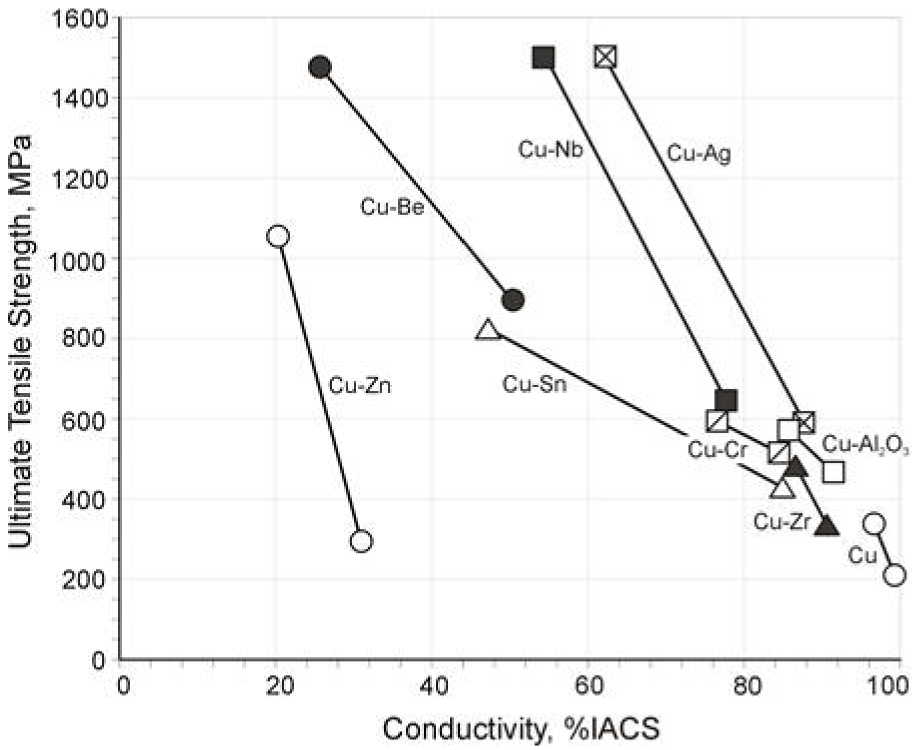

*Anisotropy in strength with respect to rolling direction for the Cu-12 mass% Ag alloy sheet. The orientation gives the longitudinal direction of the tensile test specimen with respect to the rolling direction.* [Ref: 72]



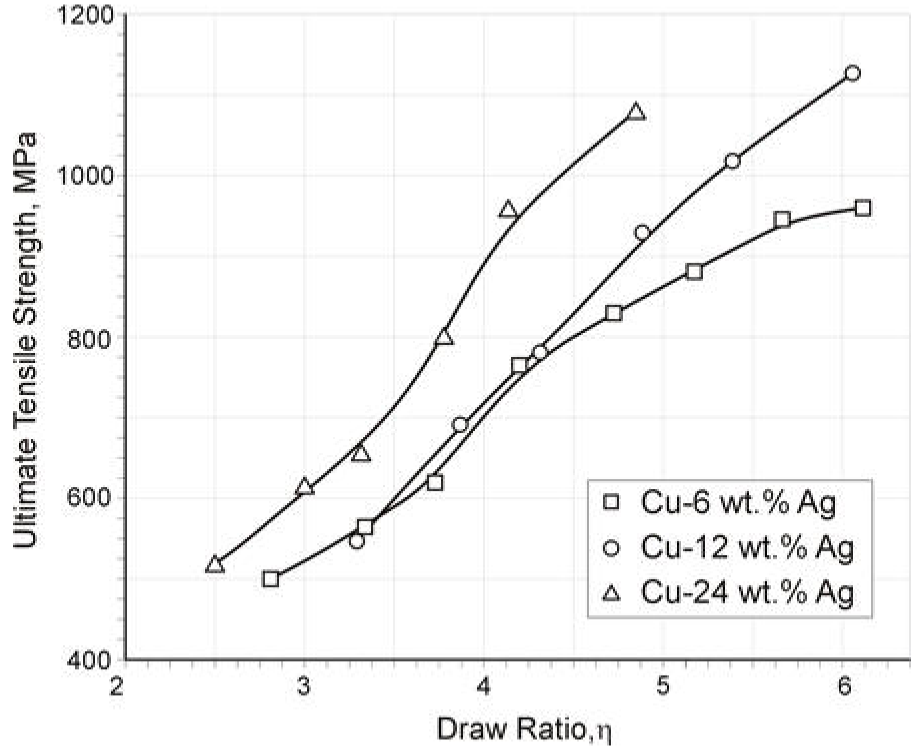

*UTS as a function of reduction ratio for the Cu-Ag alloy sheets, with varying Ag content, along with those for Cu-Cr and Cu-alumina alloys* [Ref: 75]



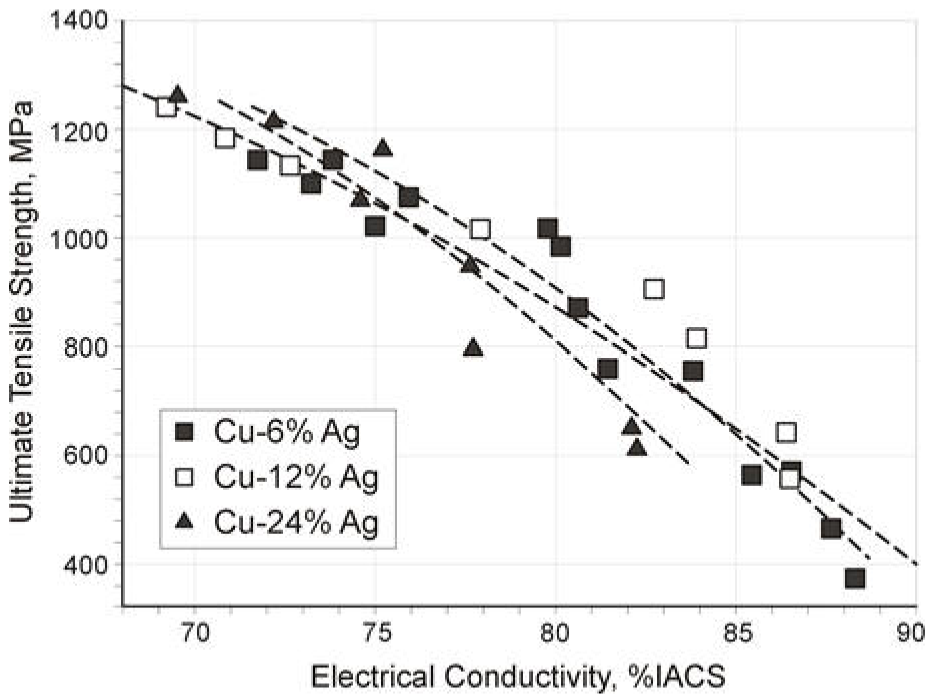

*Comparison of UTS as a function of draw ratio for the Cu-Ag wires and the Cu-Ag-Nb wire* [Ref: 77]



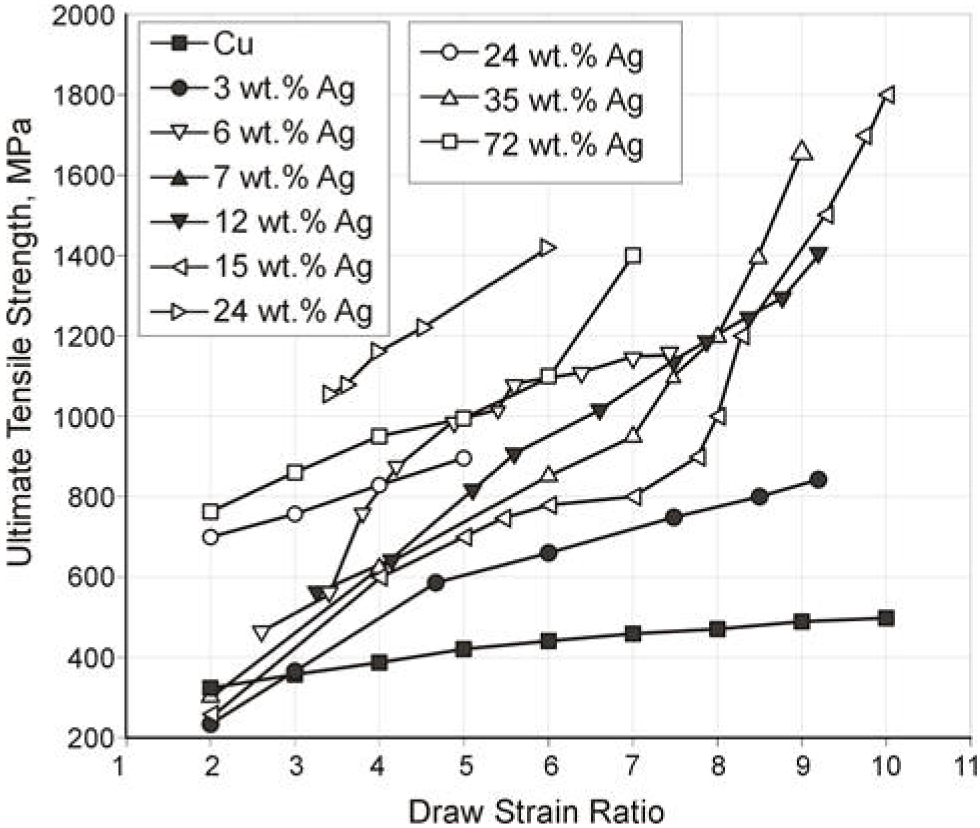

*UTS as a function of conductivity for various Cu-based alloys* [Ref: 77]



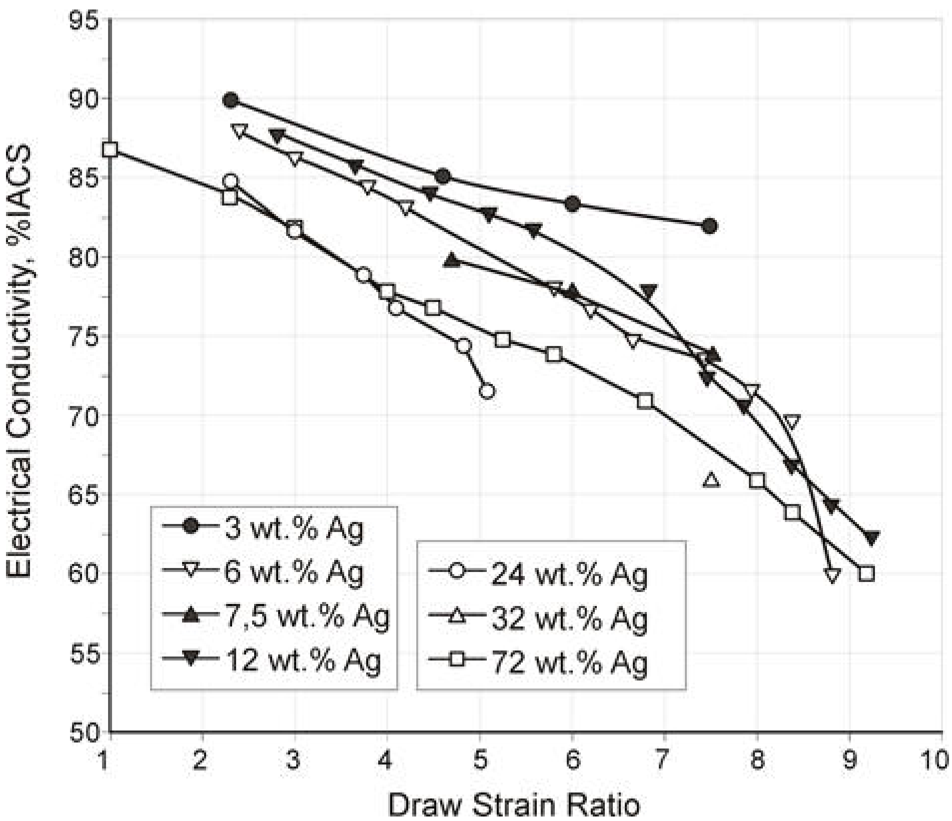

*Ultimate tensile strength dependent on draw ratio of the tested alloys* [Ref: 78]




*Relationship between the strength and conductivity of the tested alloys with different Ag content* [Ref: 79]



*Ultimate tensile strength dependent on draw strain in some alloys* [Ref: 80]



*Electrical conductivity dependent on draw strain in some alloys* [Ref: 80]

# Exploitation properties

## Heat resistance

### Mechanical and electrical properties vs temperatures

NO DATA AVAILABLE

### Long-therm heat resistance, e.g. Arrhenius curve

NO DATA AVAILABLE

### Half- softening temperature

NO DATA AVAILABLE

## Corrosion resistance

### Hydrogen embrittlement resistance

NO DATA AVAILABLE

### Other kind of corrosion elements

| Type of corrosion | Suitability | Literature |
|---|---|---|
| Atmospheric | No data | - |
| Marine environment | No data | - |
| Stress crack | No data | - |
| Hydrogen embrittlement | No data | - |
| Electrolytic | No data | - |
| Other - oxidising acids | No data | - |

## Rheological resistance

### Stress relaxation

NO DATA AVAILABLE

### Creep

NO DATA AVAILABLE

## Wear resistance

### Friction resistance

NO DATA AVAILABLE

## Fatigue resistance

### Fatigue cracking

NO DATA AVAILABLE

### Impact strength

NO DATA AVAILABLE

## Fabrication properties

NO DATA AVAILABLE

## Technological properties

NO DATA AVAILABLE

# References:

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75. **New high - strength, high - conductivity Cu - Ag alloy sheets** - Y. Sakai, K. Inoue, H. Maeda, Acta metall, mater. Vol. 43, No. 4, pp. 1517-1522, 1995

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78. **Microstructure evolution and properties of Cu – Ag microcomposites with different Ag content** - J.B. Liu, L. Menga, Y.W. Zeng, Materials S cience and Engineering A 435–436 (2006) 237–244

79. **Relationships between mechanical strength and electrical conductivity for Cu – Ag filamentary microcomposites** - J.B. Liu, l. Zhang, l. Meng, Appl. Phys. A 86, 529–532 (2007)

80. **Progress and current status in research on nanostructured Cu-Ag microcomposites for conductor wires** - L. Meng, J. B. Liu, Materials Science Forum Vols. 539-543 (2007) pp 2798-2803

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