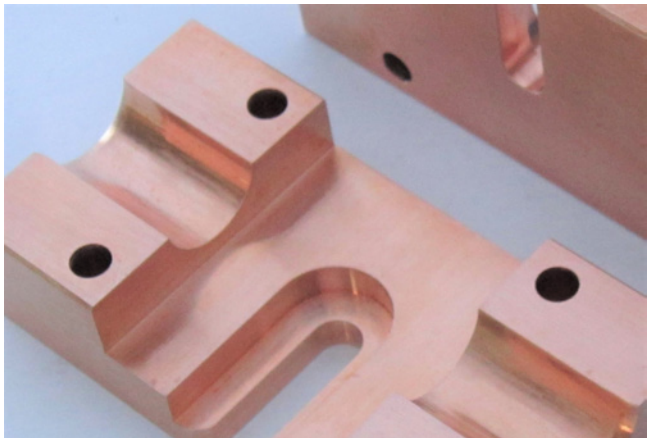
Data Sheet

CUPALOX® – The New Copper Material



Significant Characteristics and Applications

- Very good electrical conductivity
- Very good thermal conductivity
- High temperature resistance
- High hardness
- Good machinability
- Very good dimensional stability
- Non-Stick properties during resistance welding
- No toxic additives

CUPALOX® is an Oxide Dispersion Strengthened (ODS) Copper material. The material production is made by a special powder metallurgical process. The pure Copper matrix contains very finely dispersed Aluminium-Oxide nanoparticles (Fig. 1) which strengthen the Copper and lead to a higher hardness. The thermally stable Al_2O_3 particles stabilize the grain structure and boundaries up to very high temperatures. The recrystallization is prevented, there is no softening and the components keep their original shape and strength also after a very high temperature load. Due to the low proportion of Al-Oxide, CUPALOX® has an excellent electrical and thermal conductivity and is therefore particularly suitable for applications for electrical or thermal contacting.

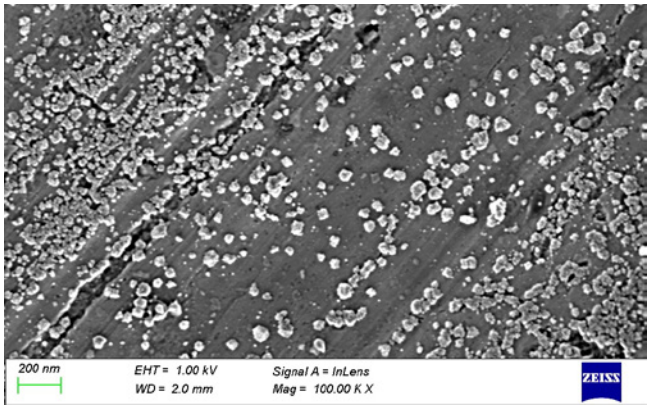


Fig 1: Finest Aluminium-Oxide-nanoparticles in CUPALOX®

CUPALOX® is used for electrical contacts, welding electrodes for resistance welding, guiding nozzles, thermally loaded conductors, heating conductors, heat sinks, radiators and others. During resistance welding of zinc-plated steel sheets, electrodes made of CUPALOX® have a special non-stick property, i.e. the electrodes do not stick or bond with the welding pieces.

CUPALOX® does not contain any toxic additives and conforms to the REACH and RoHS regulations. In many applications, the harmful Copper alloys with Nickel-, Cobalt- and Beryllium additives can be replaced by CUPALOX®.

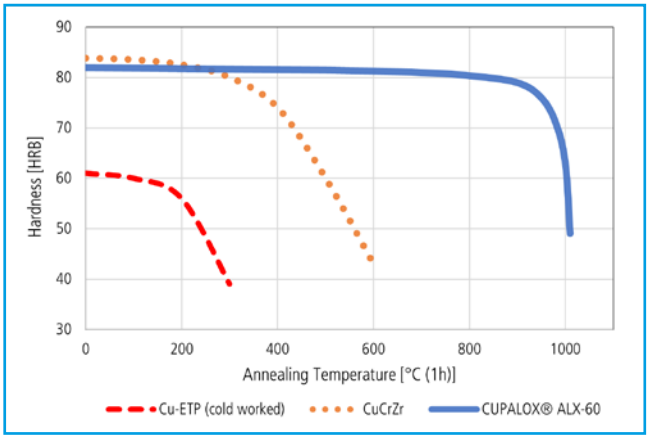


Fig. 2: Thermal stability respectively tempering resistance

Figure 2 shows the thermal stability of CUPALOX® compared to ETP-Copper and Copper-Chrome-Zirconium. Recrystallization and thus a significant softening of the material only occurs at annealing temperatures >900 °C. Pure Copper and Copper-Chromium-Zirconium already recrystallize at lower temperatures and thereby lose their hardness and stability.

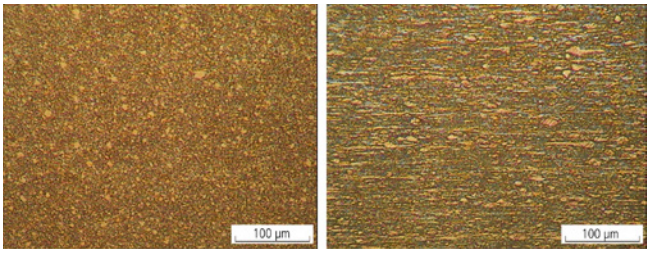


Fig. 3: Fine-grain CUPALOX® ALX-60-structure (cross-section and longitudinal structure after annealing treatment 930 °C/1 h)

Figure 3 shows the almost unchanged, fine-grain structure after a temperature treatment of 1 h at 930 °C. I.e. also after very high and frequent temperature loads, CUPALOX® contacts or electrodes keep their original hardness and shape.

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Machining

Machining is very good. With low and medium Al_2O_3 contents machining usually results in short coil or spiral chips and with higher contents rather short curly or crumbling chips are formed. In general a very good surface quality can be achieved by turning or milling. Non-cutting is possible as well, preferred in annealed condition.

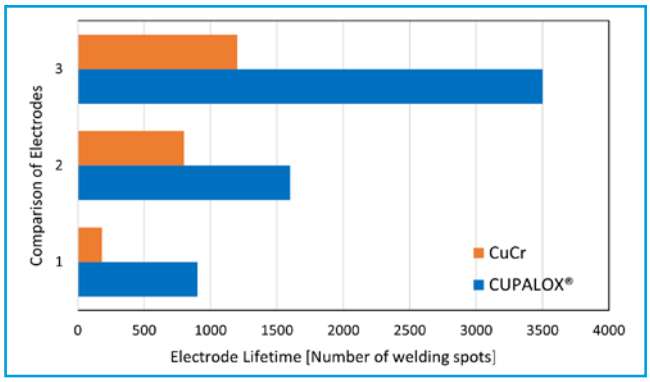

Fig 4: Lifetime of welding electrodes

Depending on the electrode type and operating parameters, welding electrodes made of CUPALOX® materials typically achieve a double to fivefold durability compared to CuCr or CuCrZr materials. Figure 4 schematically shows some test results in comparison.

Typical Applications

CUPALOX® ALX-15 / ALX-25:
Heat sinks, vacuum tubes, microwave tubes, X-ray tubes, electrical connectors, contact brushes, radiators, heat conductors

CUPALOX® ALX-35 / ALX-45:
Flat and shaped wires for relay-switch contacts, contact and electrode holders, breaker contacts, resistance welding electrodes, electrical high-temperature connectors

CUPALOX® ALX-60 / ALX-80:
Resistance welding electrodes, contact pins, thermally highly stressed contacts and holders

Standard Specifications

DIN EN ISO 5182 C20/1; C20/2; C20/3
UNS C15715; C15725; C15735; C15750; C15760; C15780; C15790
RWMA No. 20.1576 Class 20 (Group C)

Properties of the CUPALOX® Material Types

	ALX-15	ALX-25	ALX-35	ALX-45	ALX-60	ALX-80
Copper Alloy / UNS	C15715	C15725	C15735	C15750	C15760	(C15780)
DIN EN ISO 5182:2016	C20/3	C20/2	—	—	C20/1	—
Chemical Composition						
Aluminium, Al (Al_2O_3) [%]	0.15 (0.29)	0.25 (0.48)	0.35 (0.67)	0.45 (0.86)	0.60 (1.14)	0.80 (1.52)
Copper, Cu	99.7	99.5	99.3	99.1	98.8	98.4
Others [%] max.	0.01	0.02	0.03	0.04	0.06	0.08
Physical Properties						
Density [g/cm^3]	8.81	8.80	8.79	8.78	8.77	8.75
Electrical Conductivity [% IACS*]	90-95	86-92	85-90	82-86	78-83	76-80
Specific Electrical Resistivity (20 °C) [μΩ·cm]	1.93	1.99	2.04	2.08	2.12	2.15
Coefficient of Thermal Expansion (20 °C) [10^{-6} K^{-1}]	16.6	16.6	16.6	16.6	16.6	16.6
Thermal Conductivity [W/m·K^{-1}]	350	335	325	315	310	300
Mechanical Properties						
Hardness [HRB (HV10)] cold worked	60-75(105-140)	65-78(115-150)	75-82(140-160)	78-85(150-170)	80-78(155-180)	83-88(165-185)
Hardness [HRB (HV10)] annealed (900 °C, 2 h)	58-70(100-125)	62-75(105-140)	70-78(125-150)	75-82(140-160)	78-83(145-165)	80-85(155-170)
E-Modulus [GPa]	120	125	127	130	135	140
Tensile Strength R_m [MPa] cold worked	400-500	420-550	450-600	470-620	480-650	490-660
Tensile Strength R_m [MPa] annealed (650 °C, 1 h)	320-400	340-420	360-450	380-470	400-500	420-500
Yield Strength $R_{p0.2}$ [MPa] min.	300	320	340	360	380	400
Elongation A [%]	10-25	10-25	8-25	7-25	5-25	3-20

Typical values; *IACS = International Annealed Copper Standard, 100 % IACS correspond to 58 MS/m (1.72 μΩ*cm)

Range of Products

Rods, squares, bars, tubes, profiles, plates, contacts, electrodes, heat sinks, radiators and other finished parts according to drawings.

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