

Layered Copper and Aluminum Composites and Applications



Applied Composite Material Co.

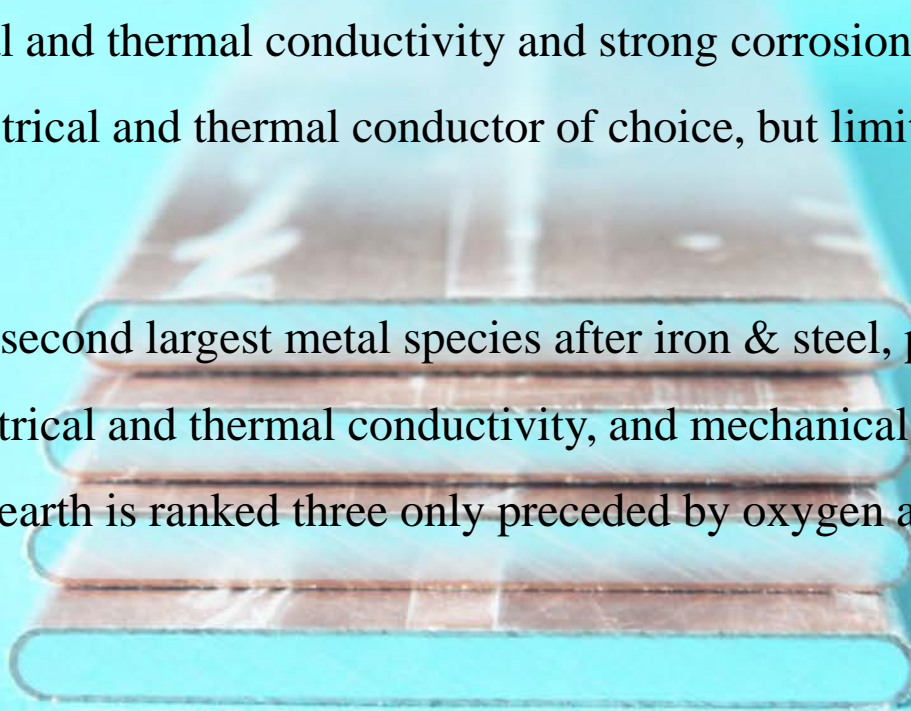
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Non Ferrous Metal - Copper and Aluminum

- * Iron(steel), Aluminum, Copper are three volume metals in the market.
- * Copper, the third largest metal species after iron & steel and aluminum, possesses excellent electrical and thermal conductivity and strong corrosion resistance, is considered as electrical and thermal conductor of choice, but limited by resource-poor and high cost.
- * Aluminum, the second largest metal species after iron & steel, possesses small density, good electrical and thermal conductivity, and mechanical ductility, its reservation in the earth is ranked three only preceded by oxygen and silicon, resource-rich and low cost.



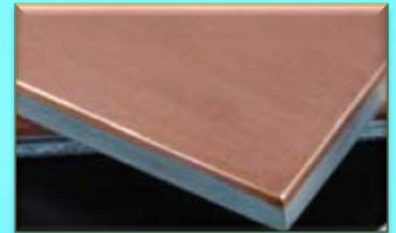
Copper Clad Aluminum Composites

- * Copper clad aluminum composite (“CCAC”), possesses physical, chemical and mechanical properties of copper and aluminum, is characterized as good electrical and thermal conductivity, good corrosion resistance, light weight and affordability.
- * CCAC not only provides solutions to aluminum in welding, ceasing-arc, less wearable, but also resolves the issues of copper in heavy mass, low intensity, resource-poor and high-cost of application limitations.

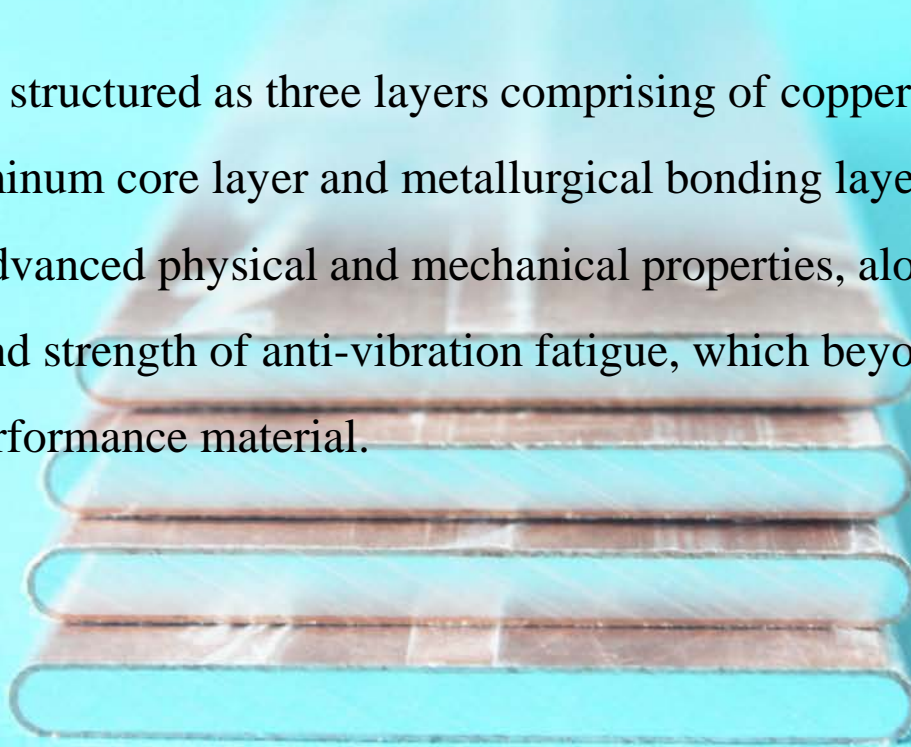


Layered Copper Clad Aluminum Composites

The bimetal interface of CCAC has achieved metallic bonding and Generated intermediate compounds due to fabrication processing.



The layered CCAC, structured as three layers comprising of copper cladding layer, aluminum core layer and metallurgical bonding layer, possesses various advanced physical and mechanical properties, along with anti-blast, superior intensity and strength of anti-vibration fatigue, which beyond a single metal, is an excellent overall performance material.

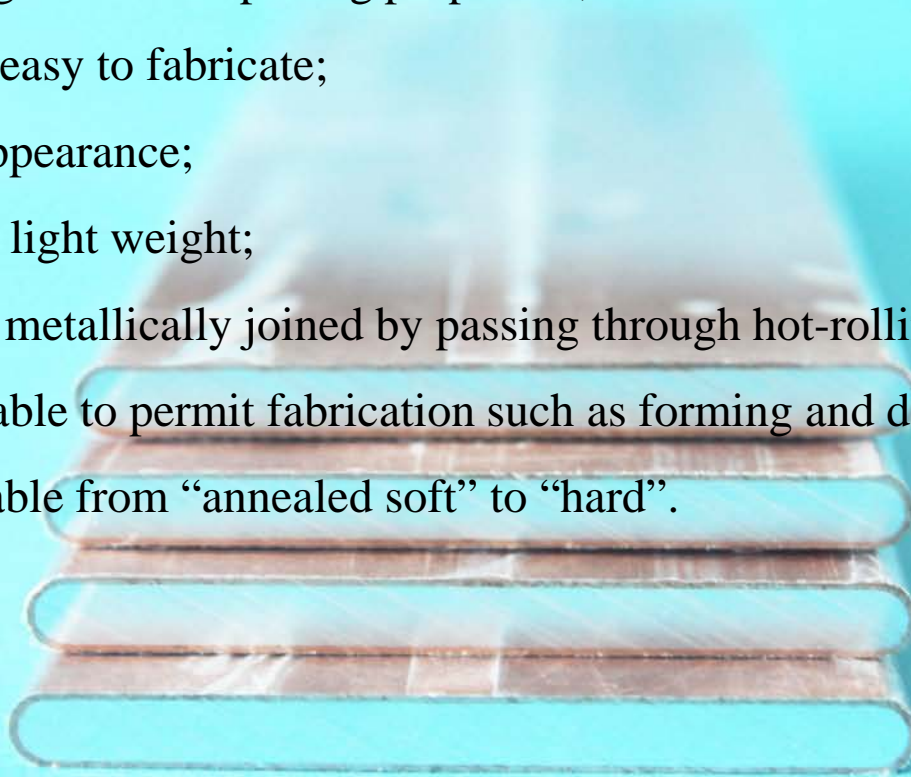


Characteristics of Layered CCAC Composites

- High electrical and thermal conductivity;
- Excellent soldering and electroplating properties;
- Highly malleable, easy to fabricate;
- Provides classic appearance;
- High intensity and light weight;
- Bimetal layers are metallicity joined by passing through hot-rolling & deformation;
- Sufficiently malleable to permit fabrication such as forming and deep drawing;
- Tempers are available from “annealed soft” to “hard”.



Solid Phase Bonding



Methods to Produce CCAC

Three producing categories:

Solid-solid phase(SSP);

Liquid-Solid phase(LSP);

Liquid-liquid phase(LLP).

** The SSP includes the methods of explosion, extrusion, explore welding and hot rolling, rolling, diffusion, diffusion and welding, isothermal, and so on.

** The LSP includes the methods of casting, reversed solidification, jet plating, braze welding, casting-rolling, and so on.

** The LLP is the electromagnetic continues casting.

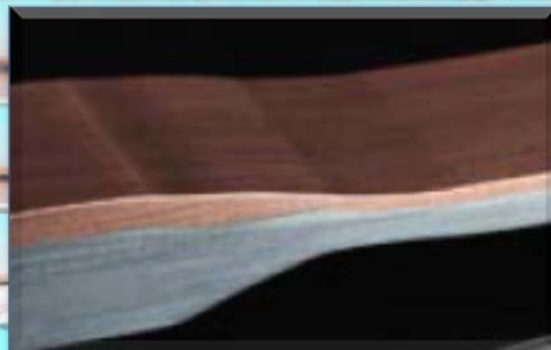
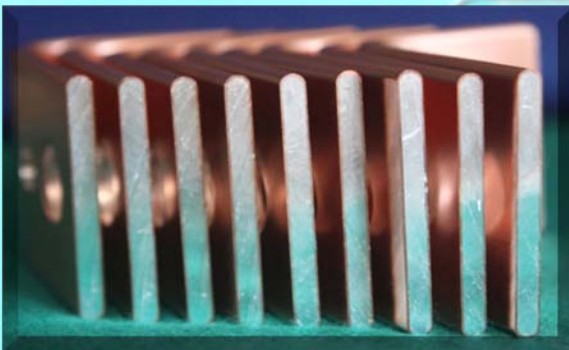
Importance of Efficiency Processing CCAC

Development of a suitable and quality CCAC fabrication process of which characterized as high efficiency, low energy consumption and short flow for scaled industrial production to provide alternative material and product to the rapid growth industries of electronics, electrical, metallurgy, machinery, automobile, energy, aeronautics and aerospace, to generate significant economic benefits due to the rational of utilization of resources, it ensures economic and social benefits on energy-saving, environmental reservation and sustainable development.

KEY to CCAC

The key to copper clad aluminum composite:

- Bimetal interface has formed the solid and reliable metallurgical bonding;
- Consistency and uniformity of cladding and core layer after rolling deformation;
- Good mechanical ductility and formability.



ACM Introduction

Applied Composite Material (“ACM”) commits to research and development of new metallic composites as well as modern manufacturing process, fabricates various specification of high quality copper clad aluminum composites (“CCAC”) in global market.

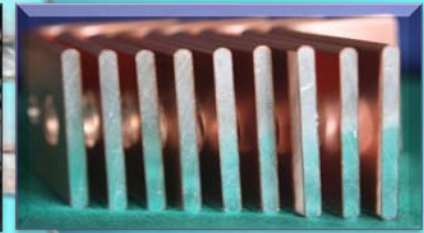
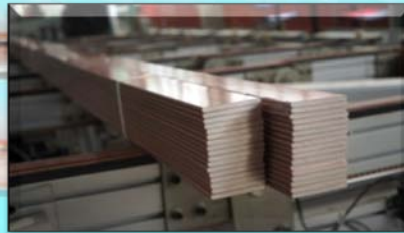
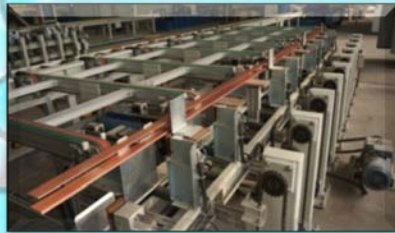
ACM factory is equipped with world-class, scaled and patented facilities of short-flow, continuous and automation processing of CCAC busbars, CCAC wires, CCAC wires, CCAC tubes and profiles.



Solid-State, Isothermal, Short-flow, Automation, Continuous Processing CCAC Products

The invented CCAC fabrication-flow starts by raw material online treatment, → flawless core layer preparation, → isothermal cladding and rolling, → online annealing and modification, → surface finishing and protective coating, → online inspection and cutting to length, → automatic collection, → robotic packing and packaging.

The CCAC fabrication system is characterized as solid-state, isothermal, short-flow, automation, high efficiency, low energy consumption and continuous processing.



Fundamental Character of CCAC Bus

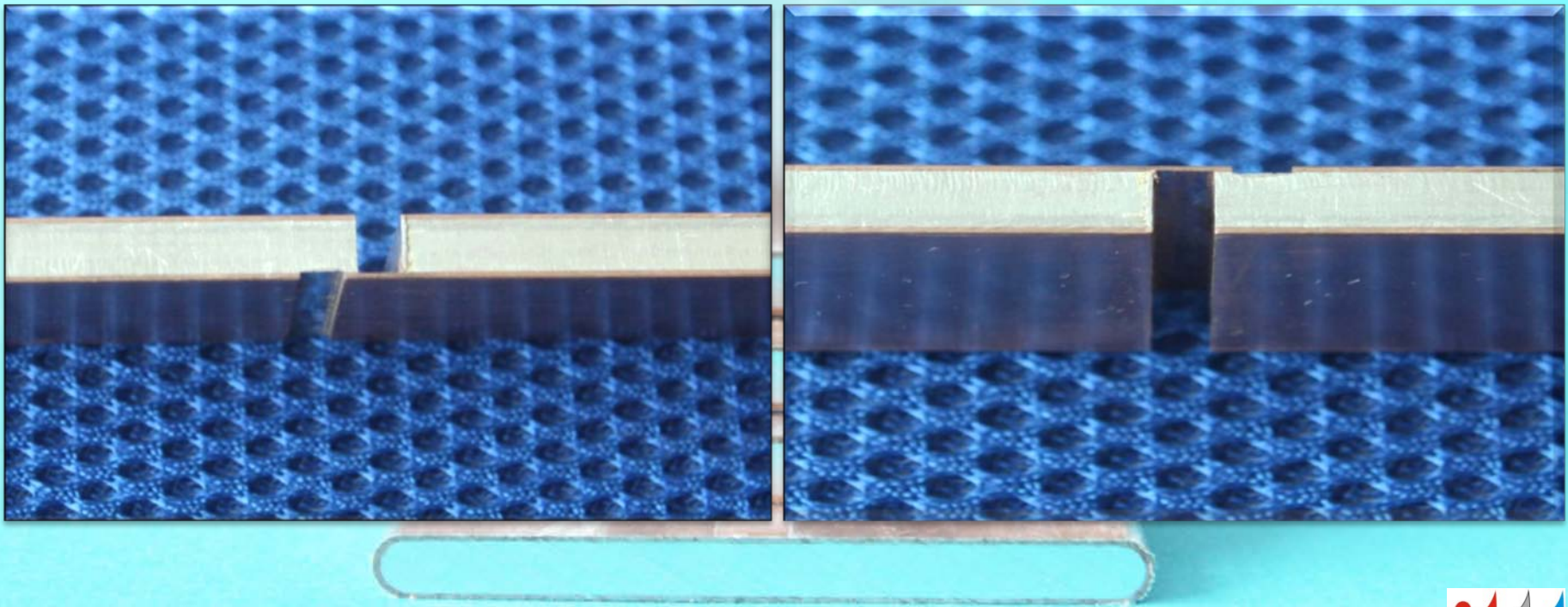
Physical character of CCAC bus:

- * CCAC Interfacial Shear Strength $> 80 \text{ MPa}$ (Industrial Standard $> 30 \text{ MPa}$)
- * CCAC Bus Bar Tensile Strength $> 110 \text{ MPa}$ (Industrial Standard $> 90 \text{ MPa}$)
- * CCAC Bus Bar Elongation $> 18\%$ (Industrial Standard $> 8\%$)



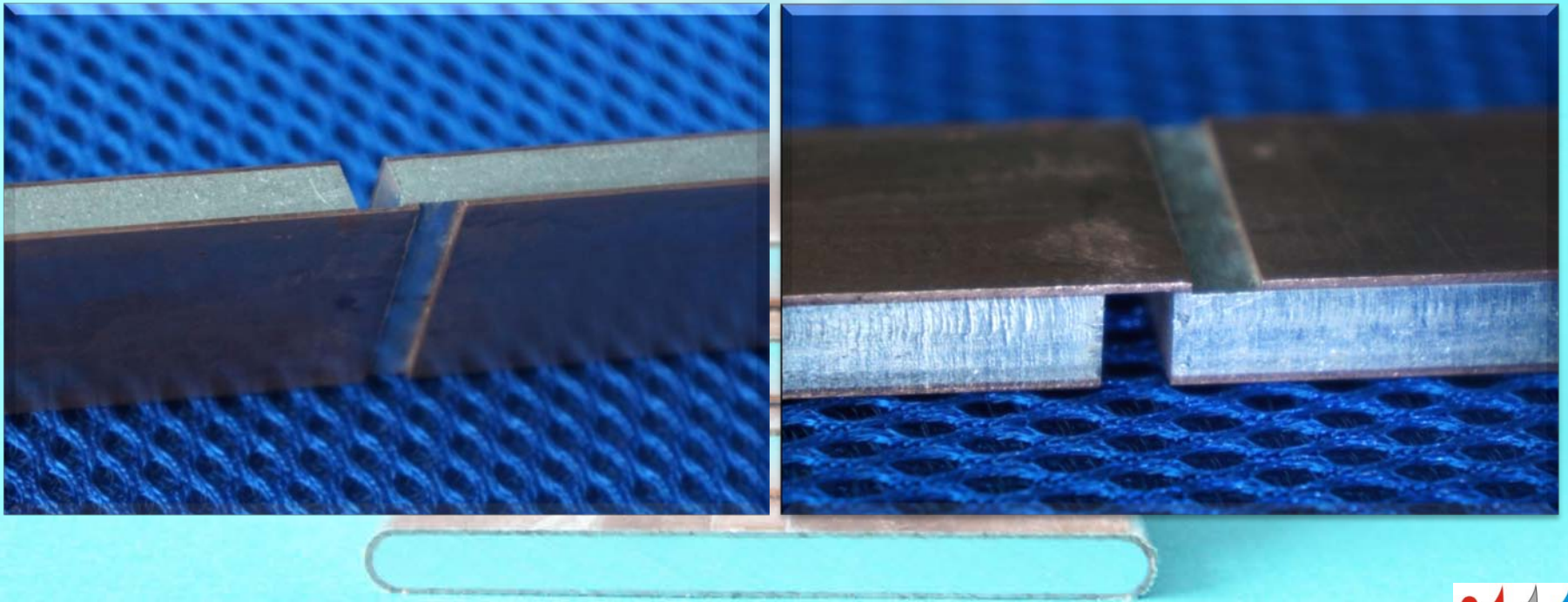
Shear Strength Test

Prepared Sample for Test
(Prior to Shear Strength Test)



Shear Strength Test

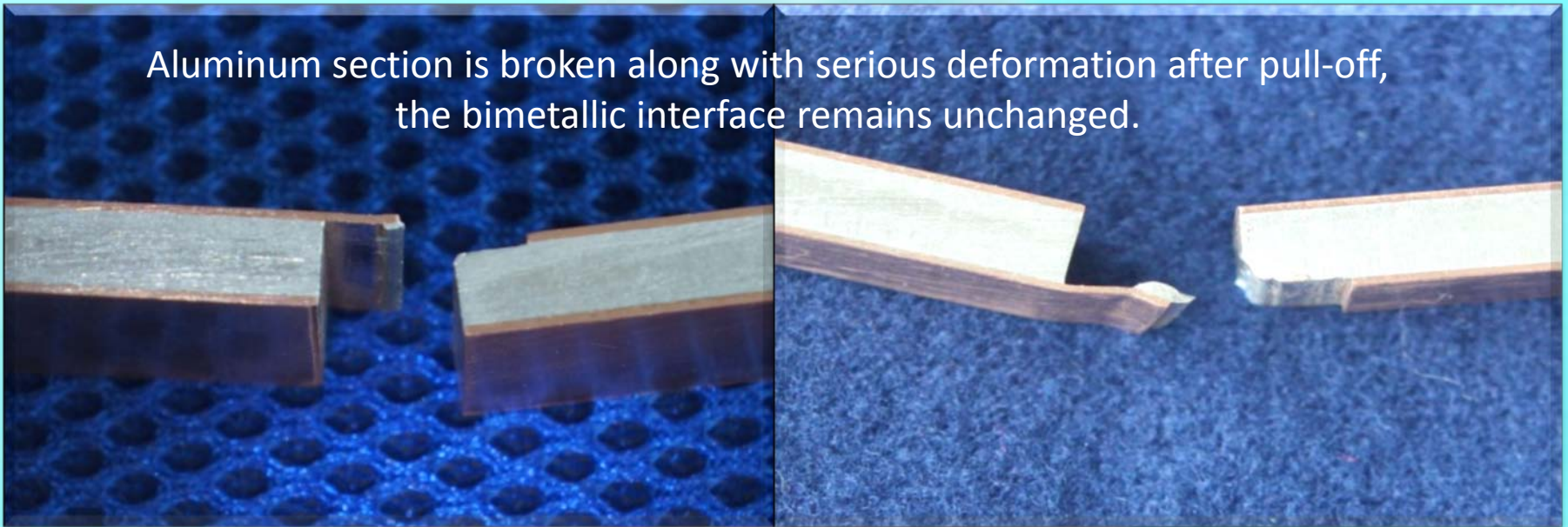
Prepared Sample for Test
(Prior to Shear Strength Test)



Shear Strength Test

Interfacial Shear Strength Test (Pull-off)

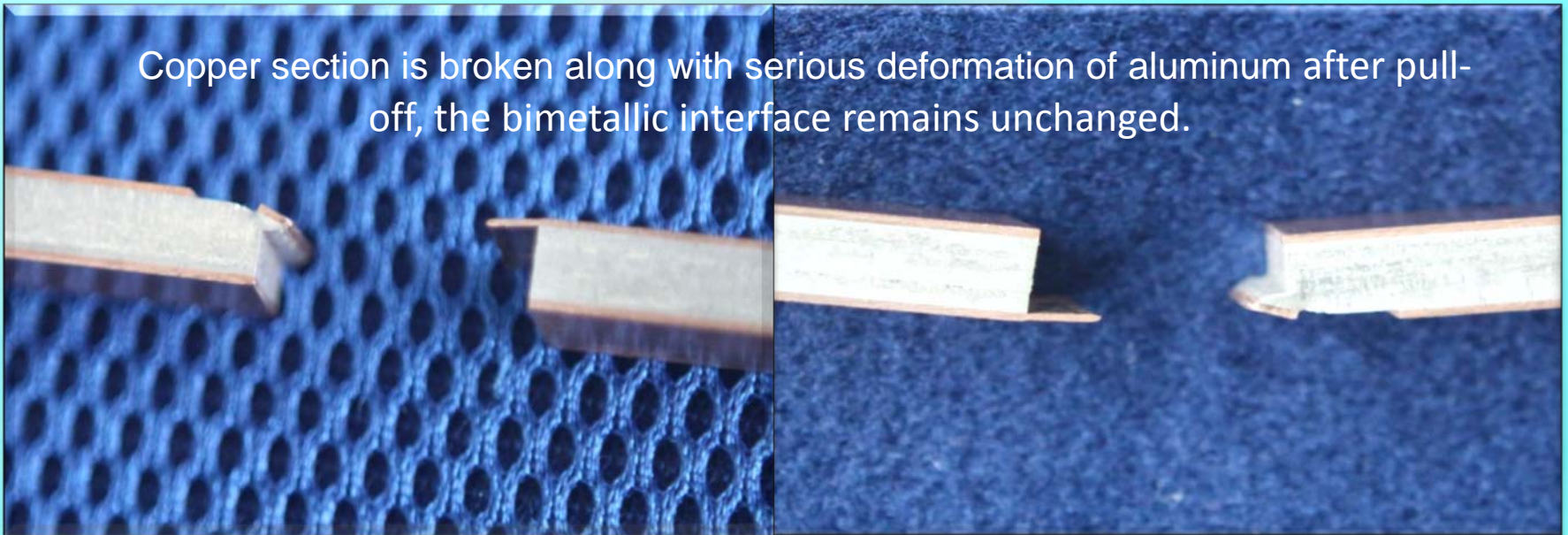
Aluminum section is broken along with serious deformation after pull-off, the bimetallic interface remains unchanged.



Shear Strength Test

Interfacial Shear Strength Test (Pull-off)

Copper section is broken along with serious deformation of aluminum after pull-off, the bimetallic interface remains unchanged.



Specification of CCAC Bus

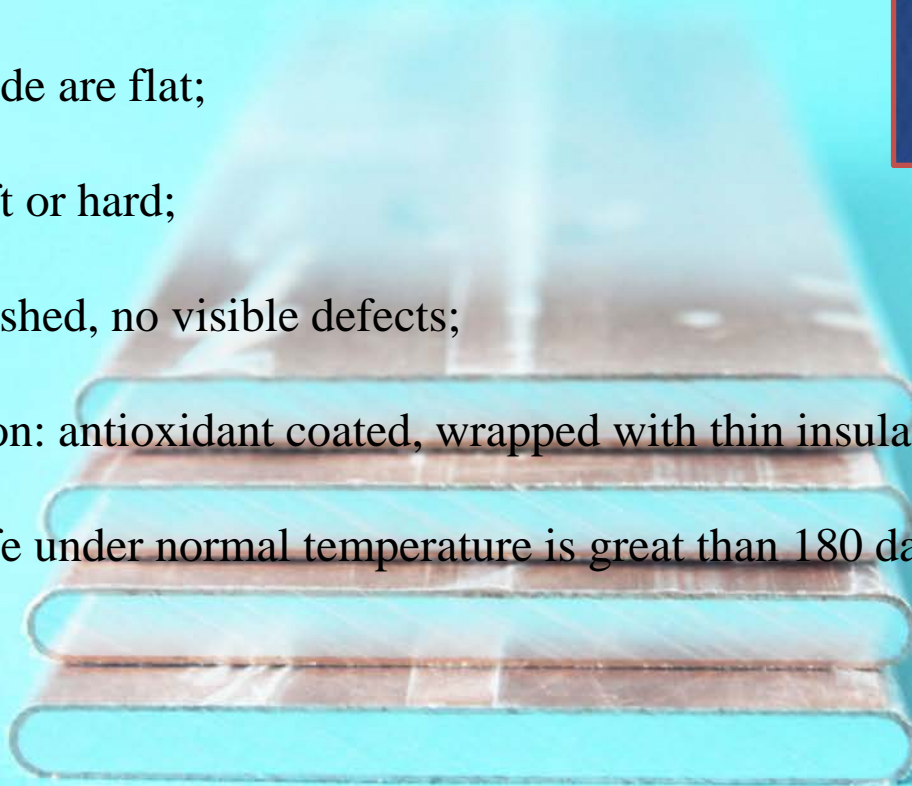
- * Copper layer cross-sectional ratio: 15%~30%;
- * Copper layer mass ratio: 30%~60%;
- * Coating layer uniformity: the thinnest layer > 90%
of average copper layer in thickness;
- * Straightness deviation $\leq 0.15\%$;
- * Tolerance: width $\pm 0.3\text{mm}$, thickness $\pm 0.05\text{mm}$.



CCAC Application: Airbus 380

Specification of CCAC Bus

- * Sectional shape: both sides are rounded, $R=1/2$ thickness; the top and bottom side are flat;
- * Temper: from soft or hard;
- * Surface: fine polished, no visible defects;
- * Shipping condition: antioxidant coated, wrapped with thin insulating plastic film.
- * Anti-oxidation life under normal temperature is great than 180 days.



Current-Carrying-Capacity of CCAC Bus

Specification (a×b) mm	Current-Carrying-Capacity (A)				
	50K	60K	65K	70K	75K
4×30	355	388	404	420	434
4×40	428	469	488	507	524
4×50	502	550	572	593	614
5×40	494	541	564	585	605
5×50	581	637	663	688	712
6×60	715	783	816	846	877
6×80	923	1011	1052	1093	1132
6×100	1075	1177	1226	1272	1317
6×120	1265	1385	1442	1497	1551
6×140	1399	1532	1594	1655	1714
6×160	1621	1775	1857	1917	1986
8×60	820	899	935	970	1005
8×80	1026	1124	1170	1214	1258
8×100	1220	1336	1390	1443	1495
8×120	1424	1560	1624	1685	1745
8×140	1627	1783	1856	1926	1995
8×160	1832	2007	2088	2168	2245
10×100	1388	1521	1583	1642	1701
10×120	1616	1770	1842	1912	1980
10×140	1849	2025	2108	2188	2266
10×160	2082	2281	2374	2464	2552
12×100	1538	1694	1754	1820	1885

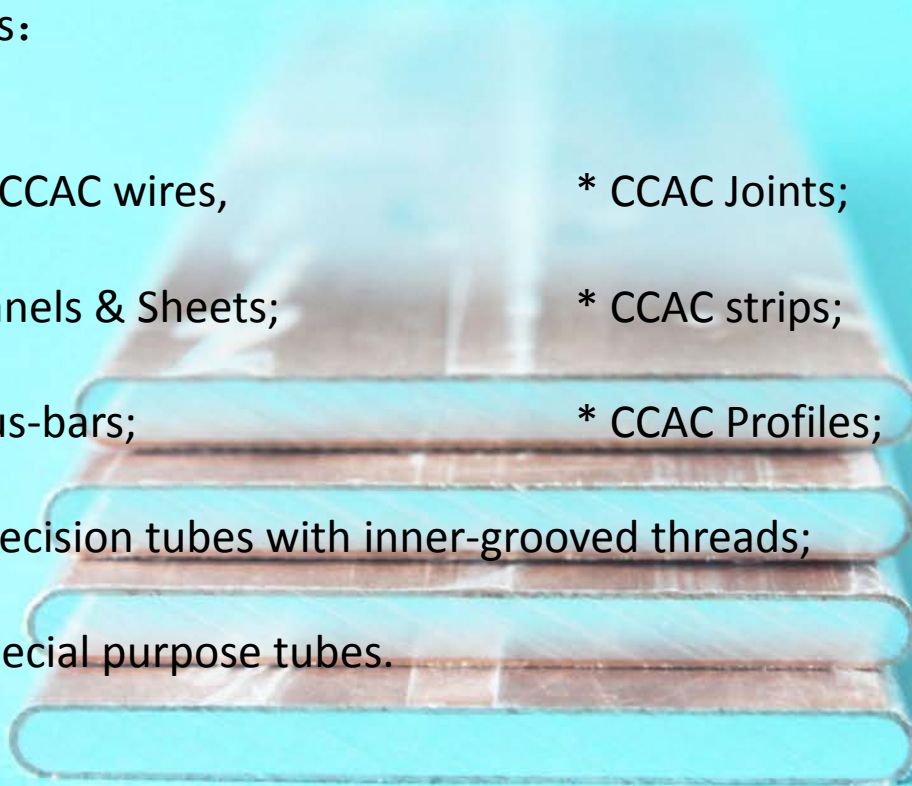
Copper vs. CCAC, Comparison of Equal Current-Carrying-Capacity

Copper Bus			CCAC Bus		
Apecification (a×b) mm	Weight Per Meter kg/m	Current- Carrying- Capacity(A)	Apecification (a×b) mm	Weight Per Meter kg/m	Current- Carrying- Capacity (A)
4×30	0.207	360	4.70×30	0.537	360
4×40	0.278	480	4.70×40	0.722	480
4×50	0.350	600	4.70×50	0.907	600
5×40	0.346	520	5.80×40	0.886	520
5×50	0.435	650	5.80×50	1.115	650
5×60	0.524	780	5.80×60	1.343	780
6×60	0.626	840	7.00×60	1.614	840
6×80	0.840	1120	7.00×80	2.165	1120
6×100	1.053	1400	7.00×100	2.717	1400
6×120	1.266	1680	7.00×120	3.269	1680
6×140	1.480	1960	7.00×140	3.820	1960
6×160	1.693	2240	7.00×160	4.372	2240
8×60	0.829	960	9.30×60	2.126	960
8×80	1.114	1280	9.30×80	2.859	1280
8×100	1.398	1600	9.30×100	3.592	1600
8×120	1.683	1920	9.30×120	4.324	1920
8×140	1.967	2240	9.30×140	5.057	2240
8×160	2.251	2560	9.30×160	5.791	2560
10×100	1.740	1800	11.70×100	4.495	1800
10×120	2.096	2160	11.70×120	5.423	2160
10×140	2.451	2520	11.70×140	6.339	2520
10×160	2.807	2880	11.70×160	7.261	2880
12×100	2.079	2000	14.00×100	5.352	2000

CCAC Applications

The wide usage and special property of CCAC promote rapid development of CCAC applications, such as:

- * Various CCAC wires,
- * CCAC Panels & Sheets;
- * CCAC bus-bars;
- * CCAC precision tubes with inner-grooved threads;
- * CCAC special purpose tubes.
- * CCAC Joints;
- * CCAC strips;
- * CCAC Profiles;



CCAC Wires

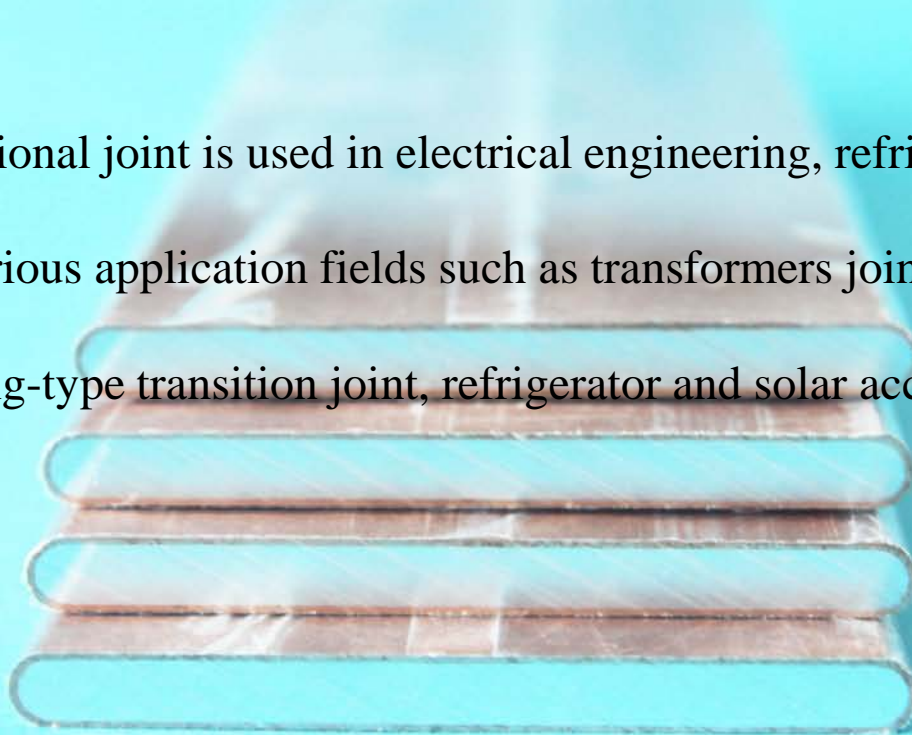
CCAC wire has been used in high-frequency transmission application with advantages:

- (1) Low density, used as inner conductor of RF cable, easy to transport and installation;
- (2) Copper to aluminum cross-sectional ratio is 15% to 85%, great saving on copper;
- (3) When use as CATV coaxial cable inner conductor, the outer conductor is aluminum tube, the coefficient of thermal expansion is close to each other which thereby increase stability and reliability of the cable;
- (4) By comparison to copper as the inner conductor of signal transmission, due to high-frequency signal transmission and "skin effect", only small difference in performance.

CCAC Connector/Joints

CCAC connector is widely used in petrochemical, electrical and refrigeration industries, due by its excellent mechanical and electrical properties and overall performance.

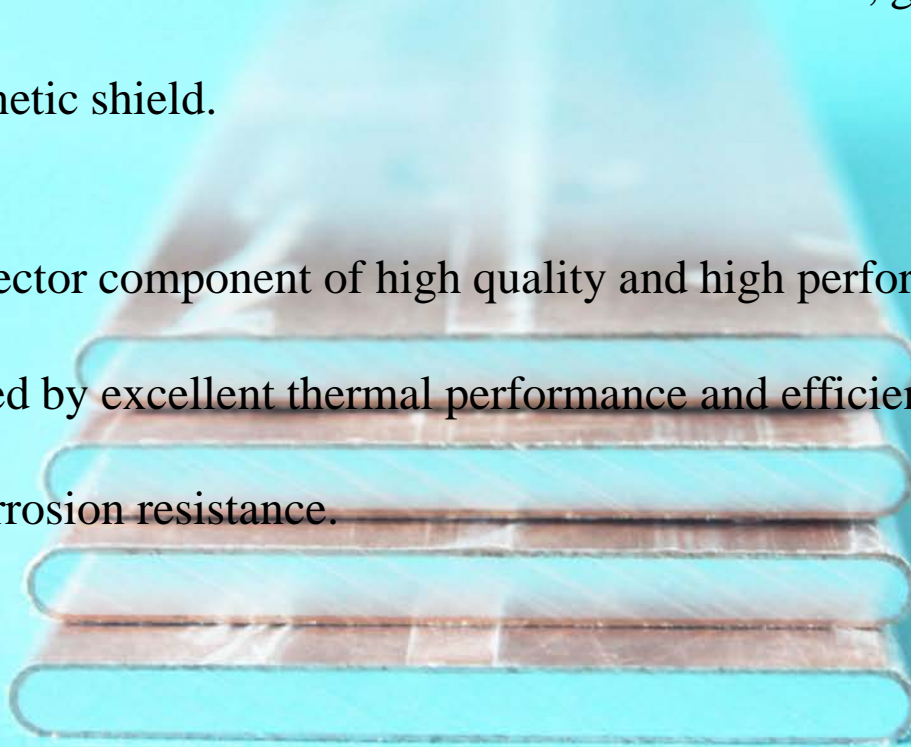
The CCAC transitional joint is used in electrical engineering, refrigeration, heating equipment and various application fields such as transformers joint, cathode crimper, DTL fitting, casting-type transition joint, refrigerator and solar acceptance device.



CCAC Panels & Strips

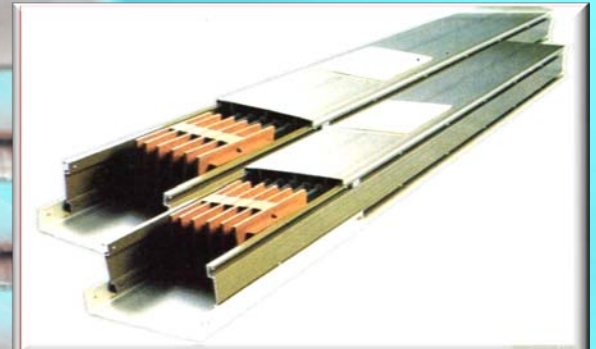
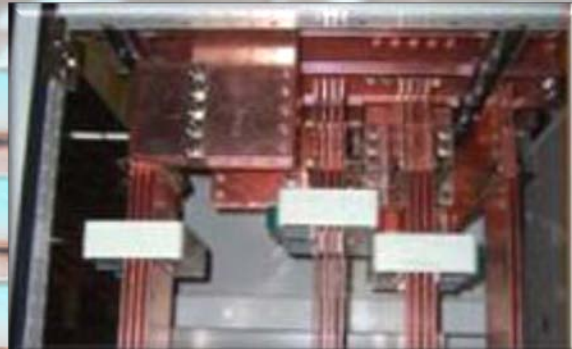
CCAC panel and strip are widely used in automobile, motorcycle, television and electronic components featured with small thermal resistance, good heat dissipation and electromagnetic shield.

As the heat collector component of high quality and high performance solar heater, it is characterized by excellent thermal performance and efficiency, long life, good pressure and corrosion resistance.



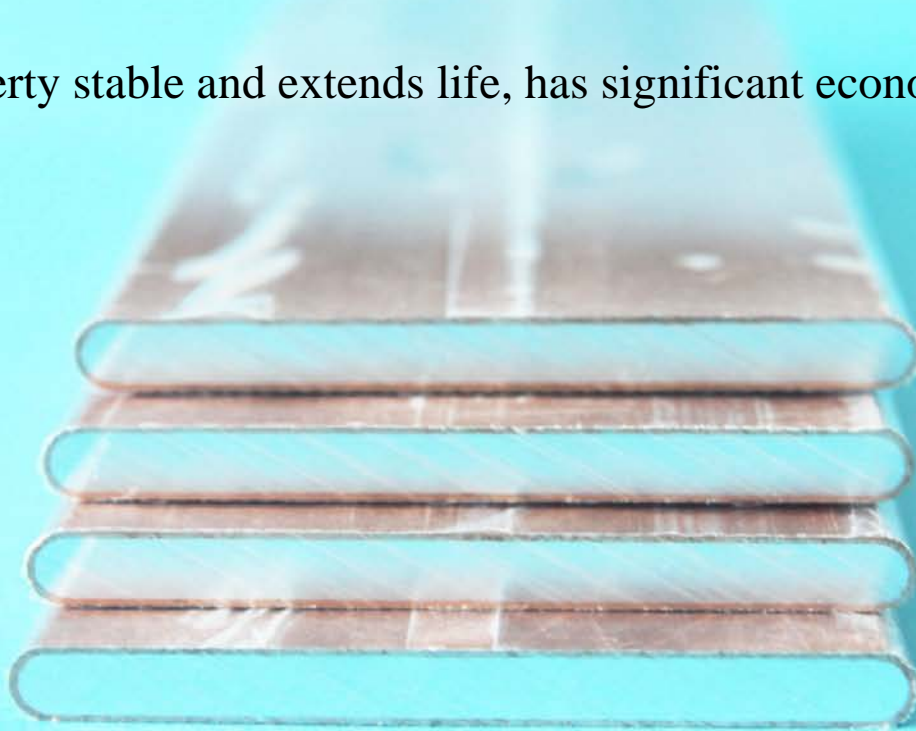
CCAC Busbars

CCAC busbar is replacing copper busbar for electrode of electrical equipment, building electricity transmission.



CCAC Flat Wires

CCAC flat-wire is replacing copper flat-wire for electrical winding coil equipment, it voids the cooked surface, arcing, overheat, reduces power consumption, ensures conductive property stable and extends life, has significant economic and practical prospects.

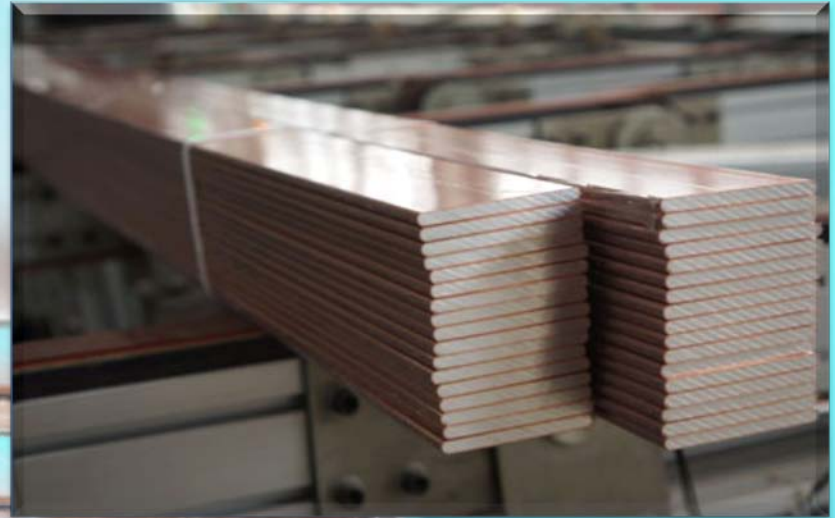


Various CCAC Tubes

CCAC tube, due to the unique three-layer structure, the strength of anti-vibration fatigue is twice as copper along with superior anti-blast capability, is used in special purpose industries and refrigeration equipments. Since the core layer of aluminum alloy is relatively soft compared to copper, the CCAC tube achieves better heat preservation effect and seal than copper tube while connects to a valve or other connecting tube, it is suitable for manufacture of air conditioning exhausting pipe, returning pipe, evaporator due to excellent heat exchange, and is used especially in aerospace, defense and other industrial applications.

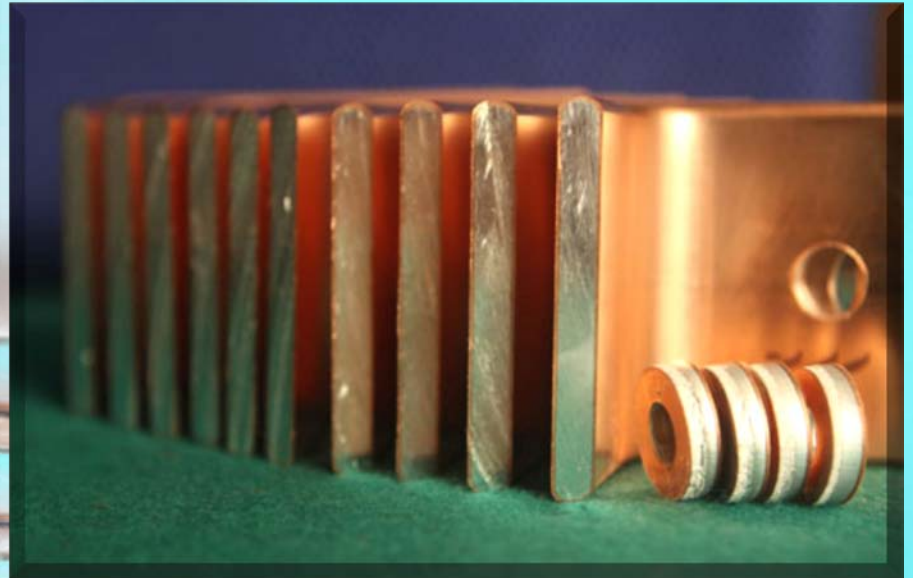
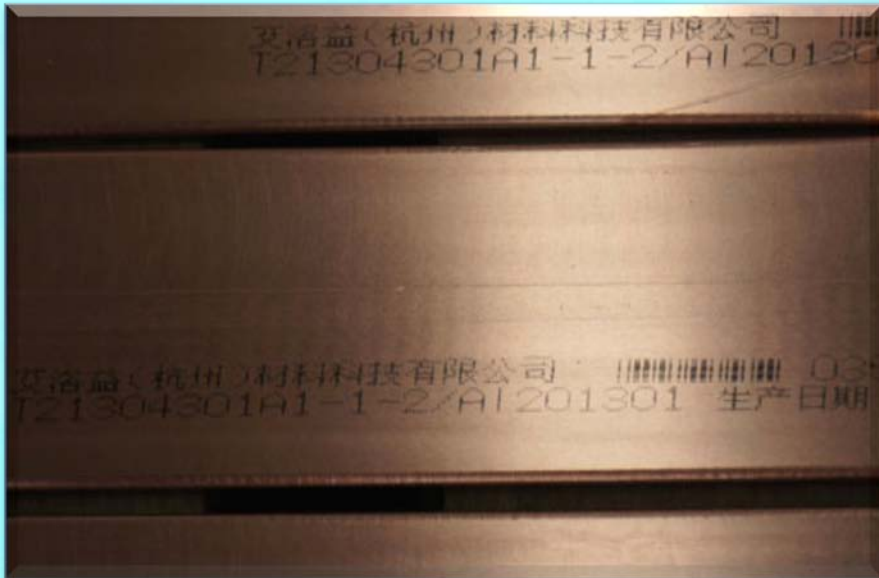
Continuous & Short-flow Automation Processing

Online automatic packing and packaging devices



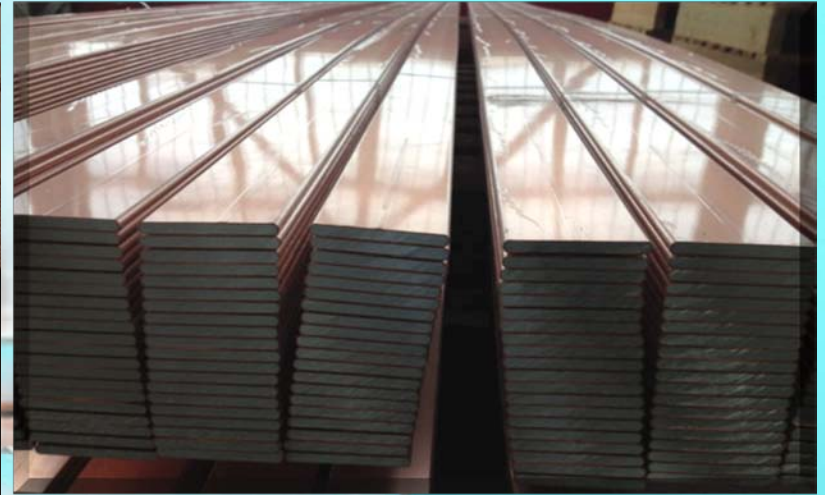
Continuous & Short-flow Automation Processing

Production coding and testing samples



Continuous & Short-flow Automation Processing

Finished products in warehouse



Continuous & Short-flow Automation Processing

Online plastic film wrapping and product collection devices



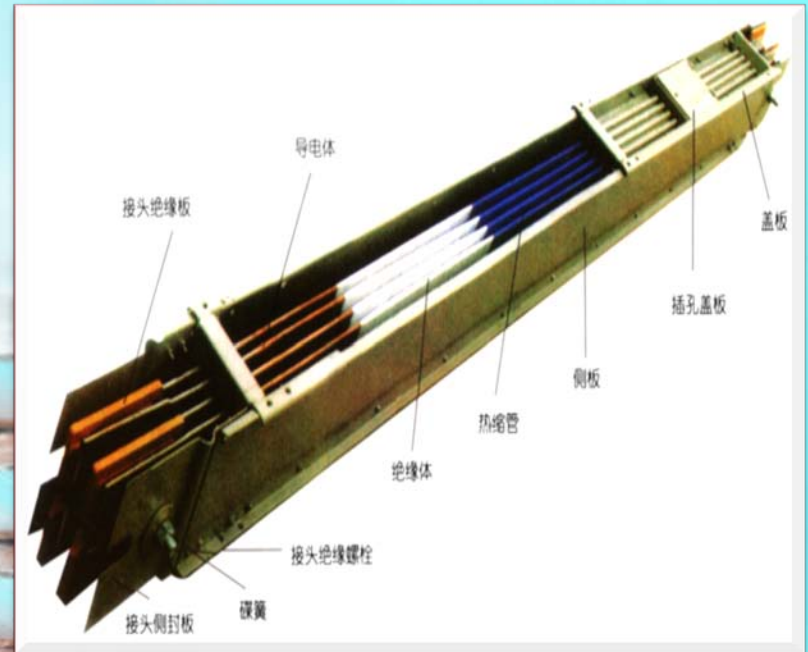
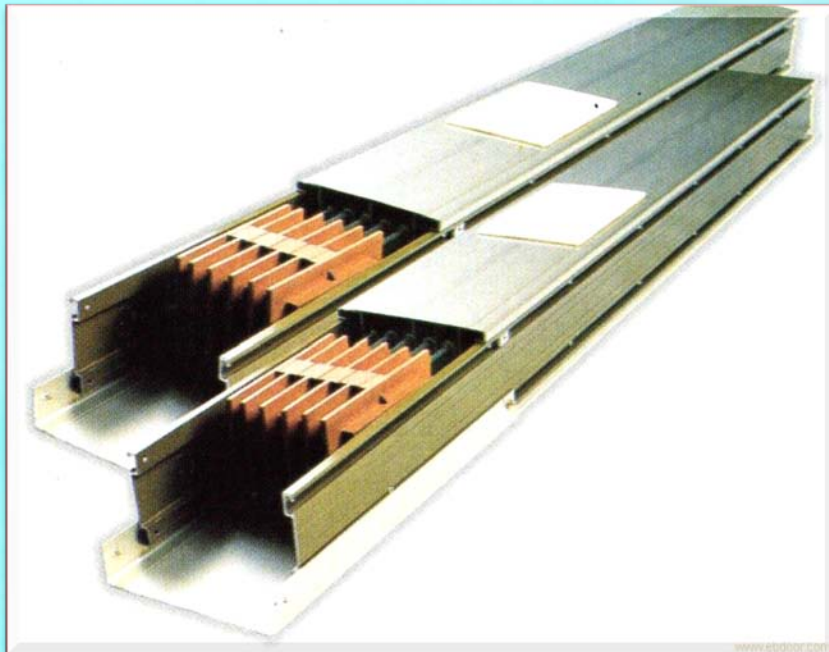
Continuous & Short-flow Automation Processing

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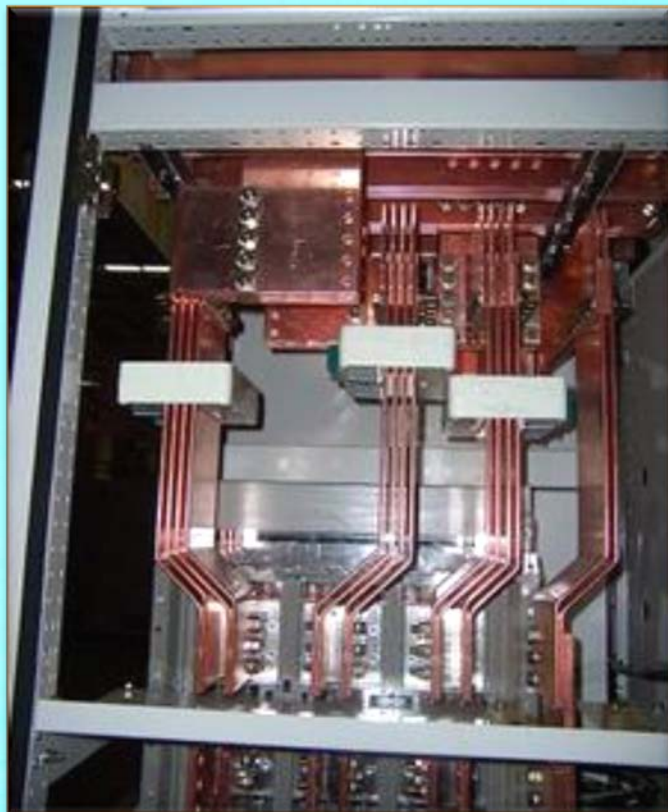
Applications

The busbar together with trunking system is widely used in buildings and stadiums for electricity transmission



Applications

Widely used as electrode, grounding terminator and wire for switchgear



Applications

Widely used as electrode, grounding terminator and wire for switchgear



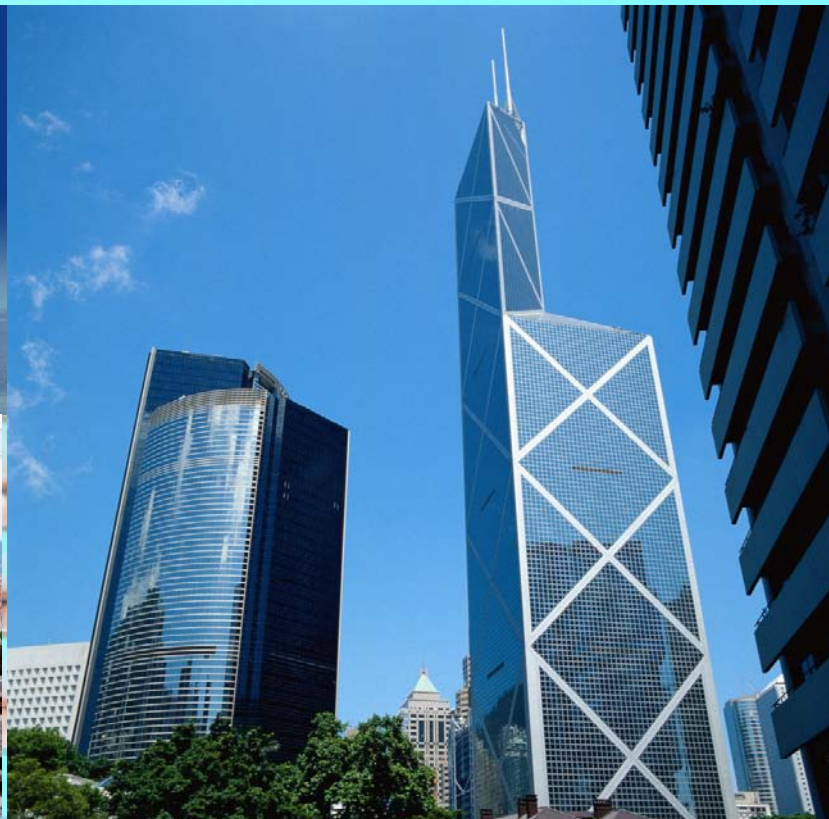
Applications

Widely used as the thermal and electrical conductor in switchgear, aeronautics and aerospace



Applications

Widely used as the thermal and electrical conductor in buildings,
Subway, cable train and ship





THANK YOU!

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