Development of a High Performance Copper Alloy EFCUBE-ST for Connectors

1. INTRODUCTION

In recent years, small-sized B to B connectors which are used for the connection between circuit boards and between modules, have been being downsized and compacted in association with the performance advancement in small-sized electronic devices such as smart phones and tablet-type terminals. Copper alloy strips used for small-sized connectors require conflicting characteristics of a high spring characteristic and of a good bending workability. Moreover, copper alloys which are less prone to permanent deformation with a good elasticity (a low Young's modulus) and have a high electric conductivity, are in demand because connectors are becoming shorter and smaller, and are reduced in their cross sectional areas. Cu-Ti alloys and phosphor bronze alloys have been mainly used for high mechanical strength copper alloys for connectors. However, in those cases, their Young's modulus and electric conductivity do not meet the requirements. To fulfill all the required characteristics in a good balance, we have developed a new copper alloy "EFCUBE-ST (UNS: C64790)" using a texture control technology. As Figure 1 shows, in EFCUBE-ST, the crystal orientations of a highly-concentrated Colson alloy in which Ni and Si density is concentrated, are controlled unidirectionally. In addition, as Table 1 shows, this product is suitable for the customers who are promoting green procurement because it doesn't include harmful elements.

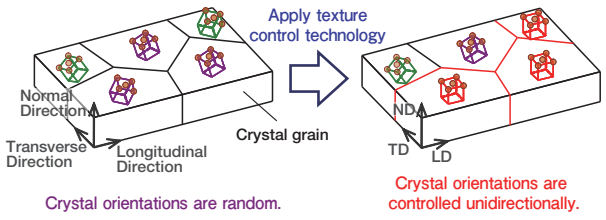

Figure 1 Texture control of EFCUBE-ST.

Table 1 Chemical composition of EFCUBE-ST.

Elements	Ni	Si	Zn	Sn	Mg	Cr	Cu
Content (mass%)	3.8	0.9	0.5	0.1	0.1	0.2	Bal.

2. CHARACTERISTICS

Figure 2 shows the basic characteristics of the EFCUBE-ST. The EFCUBE-ST has two tempers, EH and SH. Therefore, we have two types of product lines depending on the mechanical strength.

Table 2 Characteristics of EFCUBE-ST.

		EFCUBE-ST		Evaluation method
Temper		EH	SH	
Tensile strength	MPa	910	950	Tensile test JIS Z 2241 compliant
0.2% proof stress	MPa	880	930	
Elongation	%	5	3	
Young's modulus	GPa	110		—
Vickers hardness	Hv	275	295	JIS Z 2244 compliant
Electric conductivity	%IACS	35		JIS H 0505 compliant

(Bending workability)

Figure 2 shows the correlation between the strength and the bending workability. The EFCUBE-ST has higher mechanical strength (0.2% proof stress: 880-930 MPa) than the general Colson alloy and the 10% phosphor bronze alloy, while keeping a good bending workability (10 mm width, 0.15 mmt board thickness, 90°W bend: 2 to 5 t). That is comparable to the Cu-Ti alloy. Figure 3 shows the observation results of the cross sectional areas after 90°W bending. It shows that the EFCUBE-ST was processed without having a crack as well as in the Cu-Ti alloy, while the 10% phosphor bronze alloy generated a crack.

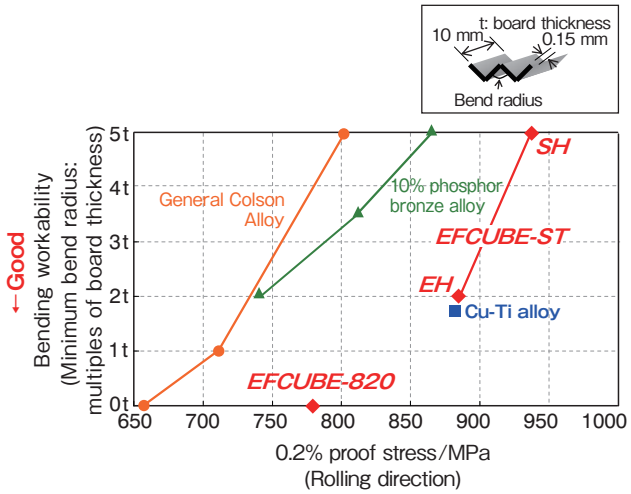

Figure 2 Correlation between strength and bending workability.

Figure 3 Cross sectional areas of bend specimens.

(Young's modulus)

Figure 4 shows the stress-strain curves (S-S curves) of the EFCUBE-ST, the Cu-Ti alloy and the 10% phosphor bronze alloy. The EFCUBE-ST shows a low Young's modulus which is comparable to the 10% phosphor bronze alloy. Compared to the materials with high Young's modulus within the same strength zone, it can keep a wide elastic area and is not prone to permanent deformation even when a certain amount of displacement occurs. Therefore, it meets the trend of downsizing in the spring parts which is required in the downsizing of connectors. In addition, because the low Young's modulus brings the elimination of size variation in the way of processing connectors, etc., the contact pressure (spring load) of the connectors' electric contacts stabilizes. Thus, it contributes to the connection reliability of connectors.

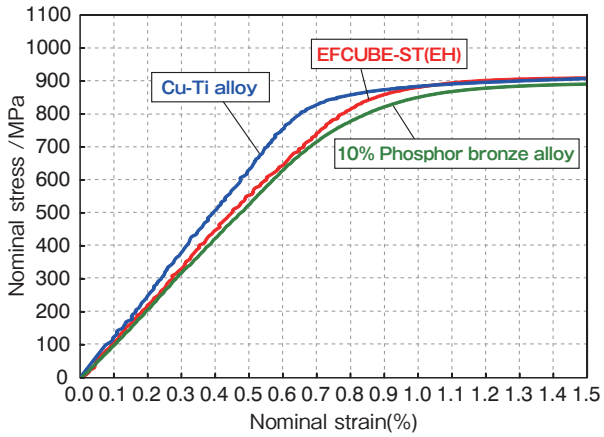

Figure 4 Stress-strain curves in rolling directions.

Figure 5 is the cobweb chart in which the characteristics of the EFCUBE-ST and other copper alloys are compared. The EFCUBE's Young's modulus is lower than that of the Cu-Ti alloy, and its strength, bending workability and heat-resisting characteristic are superior to those of the 10% phosphor bronze. Its electric conductivity is more than three times greater than that of the Cu-Ti alloy and that of the 10% phosphor bronze, which means it is highly superior to others.

As stated above, the EFCUBE-ST fulfills all the characteristics in a good balance compared to the existing copper alloys, thus contributes to the designing of the ultra-compact connectors in the next generation and the technical innovation of connectors.

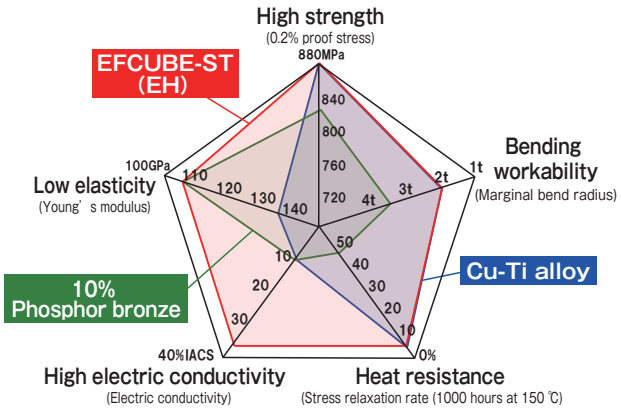

Figure 5 Characteristics of EFCUBE-ST and other alloys.

3. CONCLUSION

The EFCUBE-ST is suitable as a material for connectors which have been being downsized and highly-functionalized because of its high reliability in terms of strength, bending workability and high temperature environment.

For more information, please contact:
Sales Management Division
Metals Company
TEL: +81-3-3286-3866 FAX: +81-3-3286-3289
UNS number: C64790