

Material Search for the Masses and Wires (6)

2013/11/15 Chihiro Tokoku

- Beryllium Copper (BeCu) ... health hazard
- Zirconium Copper (ZrCu) ... C15000 (Zr 0.12-0.2%) higher thermal conductivity than BeCu
- Silver Copper (AgCu) ... C10400 (Ag 0.027-0.034%), C10700 (Ag 0.085-0.102%) etc.

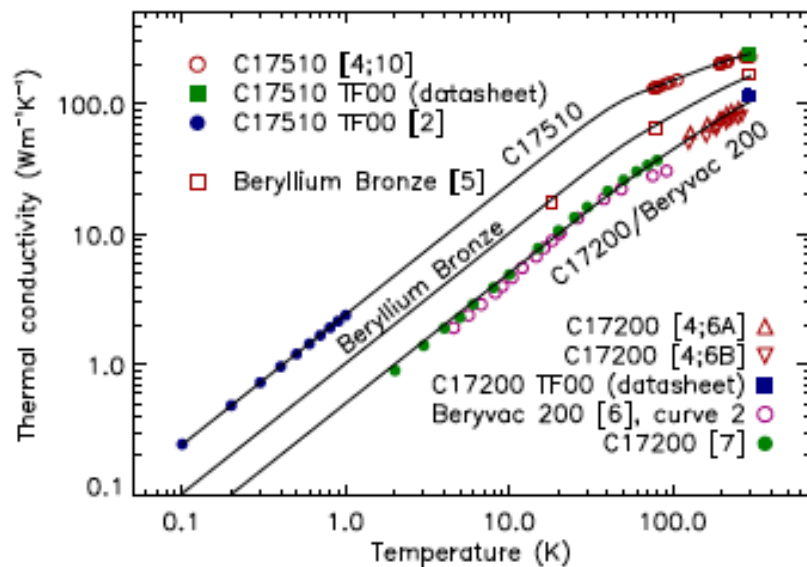


FIGURE 1. Measured thermal conductivity values for various dilute copper alloys (datapoints), along with fits using the equations from Ref. [3] (lines). References are given in square brackets; numbers following a semicolon identify different samples from a given reference.

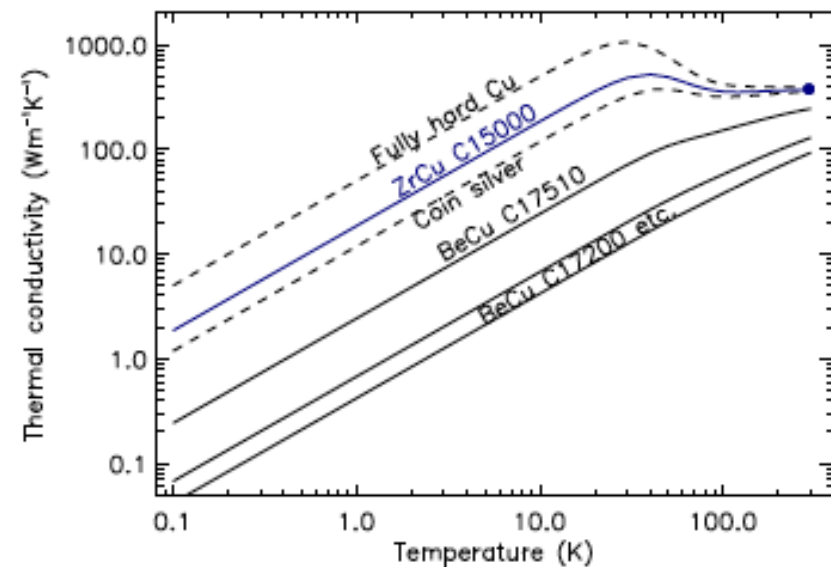


FIGURE 2. Recommended conductivity values for ZrCu and other coppers. Dashed lines are approximate.

with similar conductivity are also given in Fig. 2. The

Properties at Cryogenic Environment

	Density [E+3 kg/m3]	Thermal Conductivity [W/m/K]	Young's Modulus [GPa]	Specific Heat [J/kg/K]	Resistivity [uΩm] (RRR)	CTE [E-6/K]	Machinability (Brass=100)
Oxygen Free Copper (C10100)	8.9	~2000@30K ~460@100K ~395@300K	120-130 (@20-300K)	96@50K 255@100K 389@300K	RRR>200-300	1.0@30K 10.7@100K 18.3@300K	20
Beryllium Copper (C17500)	8.25	130@300K	120-130 (@20-300K)	233@300K		17.5@300K	40
Tellurium Copper (C14500)	8.94	356@300K	120-130 (@20-300K)	385@300K	RRR~20		85
Zirconium Copper (C15000)	8.89	~390@20K ~370@100K 370@300K	120-130 (@20-300K)	394@293K	0.0183@300K RRR=13.8, 10@300K		20
Silver Copper (C10700)	8.94	388@300K			RRR=30@300K 191@300K (annealed)	17.3@300K	20
Al6061-T6	2.71	71@60K 98@100K 159@300K	0.33@300K	~10@20K ~80@100K 960@300K	~0.02@20K ~0.04@300K RRR=2.7	24@300K	
Ti6Al4V	4.43	~2@20K ~5@100K ~10@300K	0.342@300K	~8@20K ~130@100K	<0.01@5K ~2@20K ~2@300K	8.8@300K	<10?
Silicon	2.33	2680@50K 884@100K 168@273K	Anistropic.	700@300K?		0.5@100K 1.5@200K 2.6@293K	

Measured RRR

	Cu-Ag (Cu-0.03%Ag)		Cu-Sn (Cu-0.03%Sn)		Cu-Zr (Cu-0.03%Zr)		OFC (Cu>99.99%)
Conductivity	95%IACS		99%IACS		97%IACS		101%IACS
Treatment	Non-Annealed	Annealed	Non-Annealed	Annealed	Non-Annealed	Anneal	-
RRR	30.2	191.6	9.75	12.3	3.46	10.0	~300 (C10110) ~6000 (7N)

- Measured data in red. Some candidates meet requirement (RRR~10-30).
- Cu-Sn and Cu-Ag sample by Furukawa-Electric.
- Cu-Zr and Cu-Ag sample by Hitachi-Cable.
- Annealing (400C, 1hr) and test was done at KEK (2011).

Availability

Hitachi Cable (日立電線)

ZrCu ... φ200mm x L (Lmax=1000mm), ingot

ただしインゴット(表面悪、空孔あり、残留応力あり。熱間加工、冷間加工、熱処理必要)。

AgCu ... φ200mm x L (Lmax=1000mm), ingot

ただしインゴット。3AG-OFC(C10400)のみ, 8AG-OFC(C10700)は未流通(2011.11現在)。

Contacted with Mitsubishi Material (三菱マテリアル), Furukawa Electric(古河電工)。