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Cu-based crystalline alloys with high strength and good electrical conductivity designed by glass-forming rules

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Abstract – Due to the well-balanced strength and conductivity, Cu-Be alloys have been conventionally used for the material of electrical contacting parts. However, improved materials with higher performances are strongly required for parts miniaturizing and environmental issues of Be. Several Cu-based glassy and crystalline alloys designed by glass-forming rules have reported. Recently, we have developed Cu-Zr-Ag alloys with a strength of 1210 MPa and a conductivity of 35 %IACS prepared by combined process of casting, cold-rolling and annealing. In this paper, we intend to present performance of developed alloys and discuss the possibility for electrical contacting application.

Recent progress of miniaturized and sophisticated electronics requires smaller parts with high performance. In particular, electric connecters or wire-harnesses are also required to have contradictory properties of high strength, elasticity and good electrical conductivity. In such circumstance, phosphor bronze, Corson (Cu-Ni-Si) alloy and beryllium copper (Cu-Be) alloys have been conventionally used as electric contact materials. However, alternative materials of Cu-Be alloy are strongly required because of limitation in properties improvement and environmental harmfulness of Cu-Be alloys.

Cu-based bulk metallic glasses [1] as well as a number of Cu-based crystalline alloys with high strength and good conductivity have been developed by utilization of heavily working, supersaturated solid solutions and age-hardening [2-3]. Recently, Yavari et al. have reported[1)] that rapidly solidified hypereutectic $Cu_{90}Zr_5Hf_5$ alloy exhibit high strength of 1.9 GPa and good compressive deformability of 15 % [4]. There is a possibility to develop new Cu-based crystalline alloy with high performance using the glass-forming rules [5].

Recently, we have succeeded in developing a new Cu-based crystalline alloy with high strength and good electrical conductivity. The developed alloy exhibited yield stress of 861 MPa, Young's modulus of 114 GPa, fracture strength and elongation of 1210 MPa and 2.8 %, respectively. In addition the alloy showed a good electrical conductivity of 35 %IACS.

In this paper, we intend to discuss the possibility of the developed alloy for the application of electrical contacting materials.

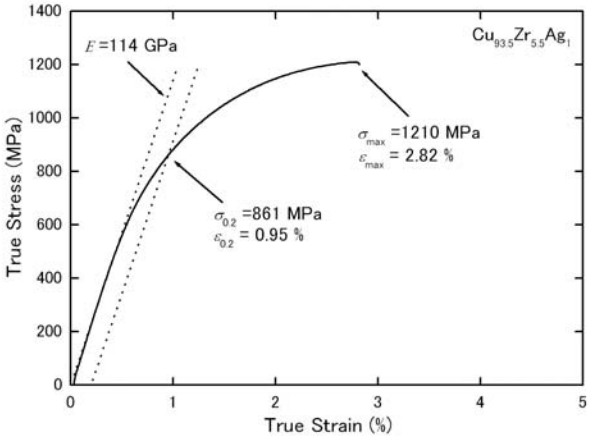

Figure 1 Stress-strain curve of $Cu_{93.5}Zr_{5.5}Ag_1$ alloy produced by casting, cold-rolling and annealing

References

[1] Q. S. Zhang, W. Zhang, G. Q. Xie and A. Inoue, Mater. Trans., JIM,48 (2007) 1626-1630.
[2] H. Kimura, A. Inoue, K. Sasamori, H. Yoshida and O. Haruyama, Mater. Trans., 46 (2005) 1733-1736.
[3] H. Kimura, A. Inoue, N. Muramatsu, K. Shin and T. Yamamoto, Mater. Trans., 47 (2006) 1595-1598.
[4] A. R. Yavari et al., Acta Mater., 56 (2008) 1830-1839.
[5] A. Inoue, Mater. Trans., JIM,36 (1995) 866-875.