Examinations of Cu-Ag Composite Conductors in Sheet Forms

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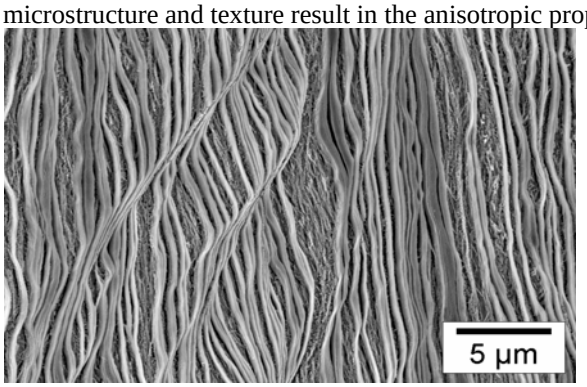
Introduction

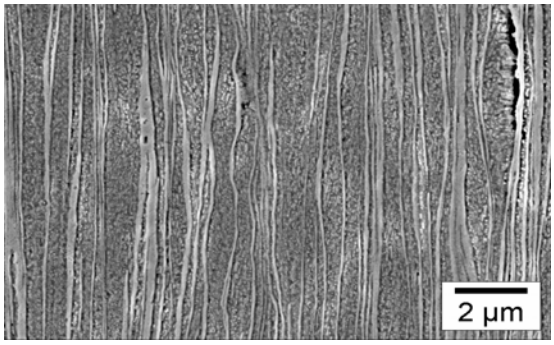
Currently, the most favorable high strength conductors are the fiber-reinforced metal-metal composites. One of those conductors is made of Cu and Ag. After deformation to large strains, the material evolves into nanostructured composite that leads to a high strength [1]. Cold rolling is the preferred method for deformation of Cu-Ag sheet into nanostructured composite for Florida-Bitter magnets. The refinement of the microstructure is accompanied by the development of the texture. Therefore, sheets produced by rolling exhibit anisotropic properties in addition to development of nanostructure and lattice distortions [2]. This report discusses our work on a characterization of the rolled Cu-24 wt% Ag sheets.

Results and Discussion

The CuAg conductors are received in a sheet form from Tanaka Kikinzoku International of Japan. The nominal Ag content is 24wt%. The sheets are deformed to strains of 97% and 99%, which resulted in 0.29 and 0.64 mm thickness, respectively [3]. The orientation of the texture components for both sheets includes a strong <133> $\{0\bar{1}1\}$ and a weak <110> $\{\bar{1}10\}$. The deviation from the standard Brass-rolling texture is attributed to the co-deformation of the two phases via severe plastic deformations. The microstructure shows that the $Cu_{76}Ag_{24}$ lamellae structures are more uniformly distributed in the transverse section (T-S) direction than those in the longitudinal section (L-S) direction, as shown in Fig. 1. The L-S images reveal that the lamellas are curved, presumably due to the effect of the interaction between shear bands and the lamella. As the rolling strain increases, the probability of the propagation of the shear along the shear bands increases. Therefore, a single shear band can propagate through larger numbers of lamella in 0.29 mm sheets than in 0.64 mm sheets. The presence of the shear bands in the L-S direction, which runs parallel to the RD, can be related to the discrepancies in the strength observed along the different directions. The shear bands are about 45 degrees with respect to the loading direction for RD tensile tests, and therefore make the material less resistance to flow than in LT directions. If the dislocations glide along the shear planes, there is reduced interface resistance to the dislocation motion and the flow stresses decrease. It can be concluded that the more aligned laminates improve the overall mechanical properties of the material. The anisotropy of the microstructure and texture result in the anisotropic properties.



a. SEM image of the curved lamellae in the L-S view of the 0.29 mm sheet.



b. SEM image of the aligned lamellae in the T-S view of the 0.29 mm sheet.

Fig. 1. Comparison of the microstructure in L-S and T-S views.

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References

[1] Han, K.; Embury, J.D.; Sims, J.R.; Campbell, L.J.; Schneider-Muntau, H.J.; Pantsyrny, V.I.; Shikov, A.; Nikulin, A. and Vorobieva, A., Materials Science and Engineering, A267, 99-114 (1999)
[2] Han, K.; Lawson, A.C.; Wood, J.T.; Embury, J.D.; Von Dreele, R.B. and Richardson, J.W. Jr., Philos. Mag. A, 84 (24), 2579 (2004).
[3] Ihara, Y. Tanaka Kikinzoku International, private communications.