LETTERS TO THE EDITOR

On the Changes of Internal Friction of Iron Fiber-reinforced Copper Composites by Cold Working

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We have already studied the deformation and annealing behaviors of mutually insoluble molybdenum or tungsten fiber-reinforced copper composites through internal friction measurements⁽¹⁾⁽²⁾. The changes in internal friction of copper composites containing fibers more than the critical volume fraction due to cold rolling showed a tendency different from that of cold worked single crystals of copper and polycrystals copper as reported previously. This may be attributed to the locking of free vibratile dislocations, which were produced by the difference in thermal expansion coefficient between matrix and fiber, by cold rolling.

In the fiber-reinforced alloys the reaction zone at interfacial boundaries between fibers and matrix has an important role⁽³⁾⁽⁴⁾. In this connection, investigations were made on the changes in internal friction by cold rolling the iron fiber-reinforced copper composites that had some solubility with each other. Iron (0.28 mm ϕ) fiber-reinforced copper composites were prepared by infiltration technique. These specimens were annealed at about 900°C for 30 min and then furnace cooled. Internal friction was measured on the annealed specimens of pure copper, copper-5 wt% iron alloy and copper base-iron composites and then the specimens were cold rolled in a direction longitudinal to the direction of reinforcement. The measurement of internal friction was started 2 hr after each pass of cold rolling for each specimen.

The reaction zone of about 50 μ in thickness was formed at fiber-matrix interface. The results obtained are shown in Fig. 1. The internal friction of copper indicated the increase with increasing reduction by cold rolling, showing a peak around 5% reduction by cold rolling. With a further reduction, the internal friction decreased and then rapidly increased. The change in internal friction of composites containing iron more than the critical volume fraction (0.068) showed a tendency different from that of pure copper and copper-5 wt% iron alloy. The internal friction decreased rapidly with increasing reduction up to about 5 to 10% and reached a minimum. With a further high reduction, the internal friction increased in a similar way to that of pure copper. Such a tend-

Fig. 1 Relationship between cold rolling reduction and strain amplitude independent internal friction. Successive cold rolling deformation was made on the same specimens.

ency of changes in internal friction qualitatively coincide with that of cold worked molybdenum or tungsten fiber-reinforced composites⁽¹⁾⁽²⁾. Thus the formation of the reaction zone cannot be considered to effect the change in internal friction of composites by cold working.

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REFERENCES

- (1) Y. Umakoshi and T. Yamane: *Trans. JIM*, **13** (1972), 160.
- (2) T. Yamane, Y. Umakoshi, M. Tomishima and K. Nakai: *Proc. of Inter. Conf. on Mechanical Behavior of Materials*, Soc. Mater. Sci., Japan, **5** (1972), 220.
- (3) G. L. Davies: *Metallurgia*, **58** (1958), 177.
- (4) D. W. Petrasek and J. W. Weeton: *Trans. Met. Soc. AIME*, **230** (1964), 977.

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