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INFLUENCE OF TEXTURE ON LOW TEMPERATURE BENDABILITY OF Zn ALLOYS

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Introduction

The bendability at low temperature of Zinc alloys can be very different from one sample to another. Dr. Wegria (1) from Vieille Montagne demonstrated that the texture has great influence in this. We have tried to explain the role of texture for the low temperature bendability of Zinc alloys.

Sample Preparation and Texture Determination

Samples of Zn Cu Ti alloys were prepared and were rolled under two different conditions. The corresponding samples, respectively referred to as Zn6 and Zn3 show a clear difference in the resulting textures. So, the Zn6 sample shows a very strong texture, with one intense prefered orientation having the C axes tilted by 20° from ND to RD in the (ND, RD) plane (fig. 1). The Zn3 sample shows the same major component but with a wide spread, so that the resulting texture is much smoother. The texture indices are respectively 6 and 4.5 for samples Zn6 and Zn3. For the two samples, the grain size and the second phase distribution are almost the same (fig. 2). The essential difference between the two samples is the texture and at 40°C the bendability of sample Zn6 is good whereas the bendability of sample Zn3 is bad.

Experimental Study

We have performed different mechanical tests in tension and in expansion at various temperatures in the range from -50°C to +25°C.

In stretching tests the yield stress is lower in Zn3 than in Zn6 but the maximal stress is the same (fig. 3). The ductility is lower for Zn6 (fig. 4). This effect is greater in Rolling Direction. In expansion the ductility is better for Zn6 and the ductile-brittle transition occurrs at a lower temperature for Zn6 (fig. 5).

Interpretation

The results can be interpreted with respect to the mechanisms of plastic deformation which are activated by the various deformation modes. In uniaxial stretching, the geometrical orientation factor (Schmid factor) of basal glide is higher in Zn3 crystallites belonging to the wide spread around the major component than it is in Zn6 for crystallites belonging to the strong major component. Thus the ducticity is greater for Zn3 than Zn6.

In biaxial expansion and bending, the compression stresses yield a high geometrical orientation factor of pyramidal glide in the marked prefered orientation of the Zn6 sample. As opposed to this, the compression stresses yield a rather low geometrical orientation factor of the pyramidal glide in Zn3 for crystallites belonging to the wide spread around the major component and for the basal glide as well, in this particular deformation mode.

This is confirmed by the micrographies. In the strongly textured Zn6 sample,the major part of the grains have nearly the same orientation, with the result that the easy glides can cross the grain boundaries and propagate further all the grains .

In the less strongly textured Zn3 sample with a wide spread and more disoriented grains, the easy glide can not easily cross the grain boundary and a second glide system becomes active. At low temperature the stress in grains boundaries with large disorientation can induce microcracks on the clivage plane (0002) in a grain which is not well oriented and induce the breaking . In most cases, the C axes in these not well orientated grains made a large angle with ND (50°).

A study on ZnCu alloys with large grain size (100 - 200 µm) show that the breaking becomes rapidely at the grain boundaries with large desorientation and when the c axe in the grain is tilted at more than 70° from Normal Direction (fig. 6).

Conclusion

The results obtained clearly show that the ductile fragile transition of the studied Zn-Ti-Cu alloys is influenced by both the orientation (orientation density function) and the orientation correlation (misorientation density function) of the grains. A study of individual orientation of grains and a misorientation between grains has been named. Both structural parameters could be optimised to adequate rolling and/or thermomechanical treatments.

(1) J.Wegria rapport CRM NF 6/85 Zn 261
(mai 1985)

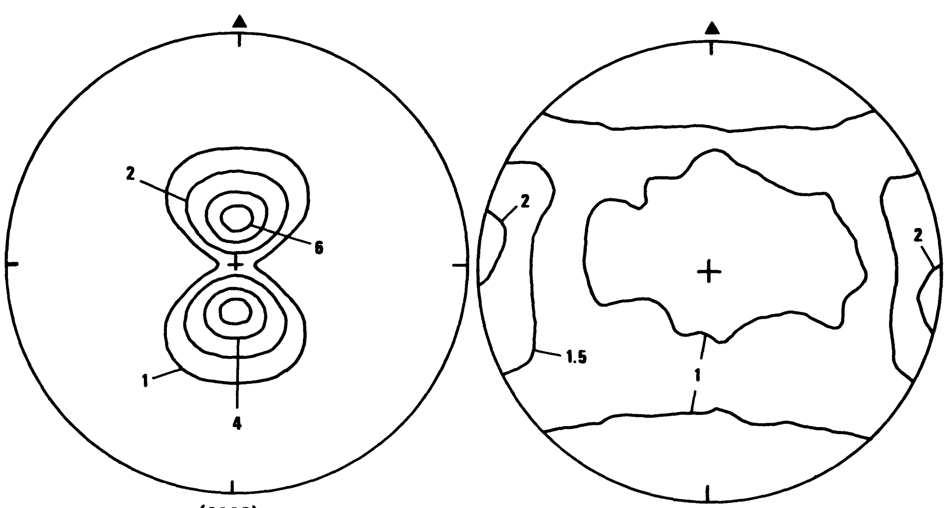

Figure 1 : Poles figures of Zn6 (50% rolling)

Figure 2 : Microstructure form Zn3 and Zn6

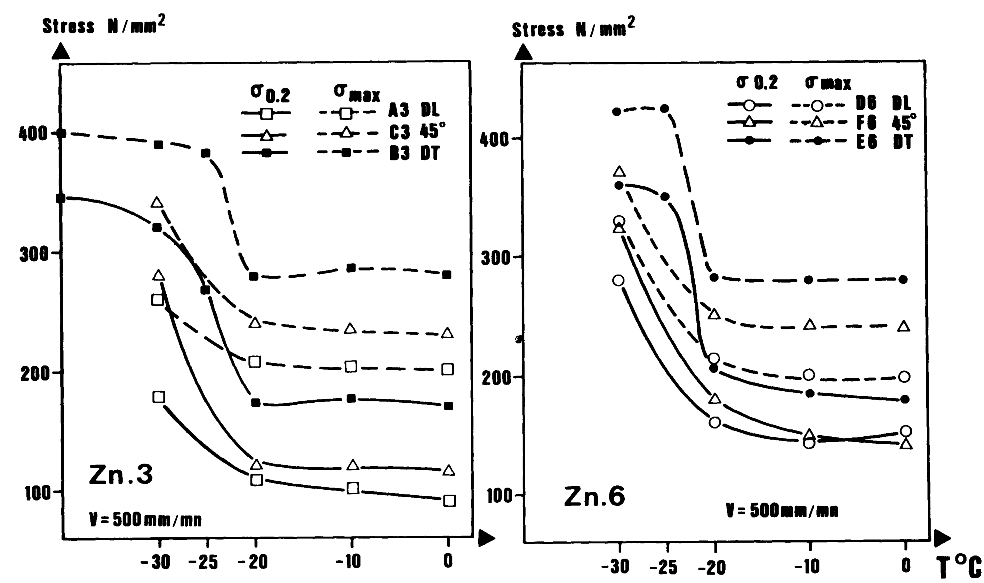

Figure 3 : $\sigma_{0,2}$ and σ_{max} versus temperature.

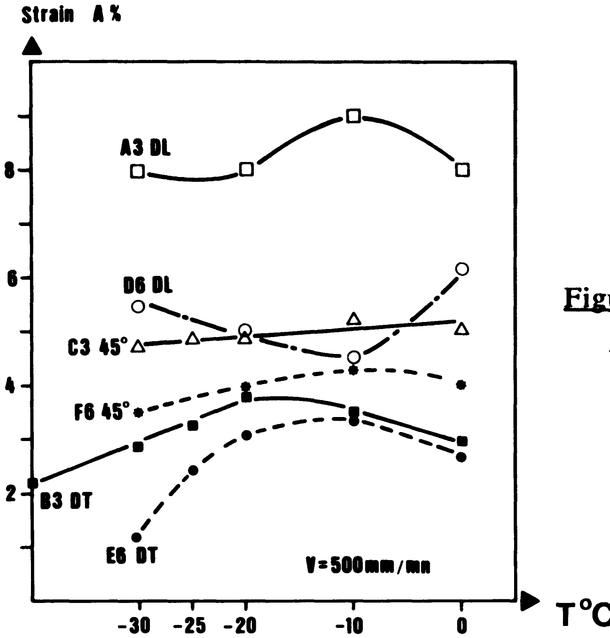

Figure 4: Plastic strain versus temperature.

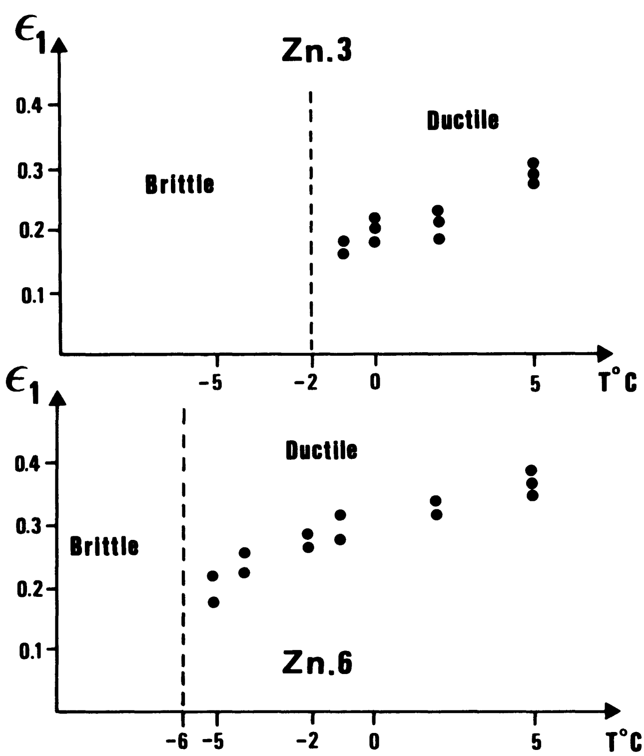

Figure 5: Ductile-Brittle transition in biaxial expansion.

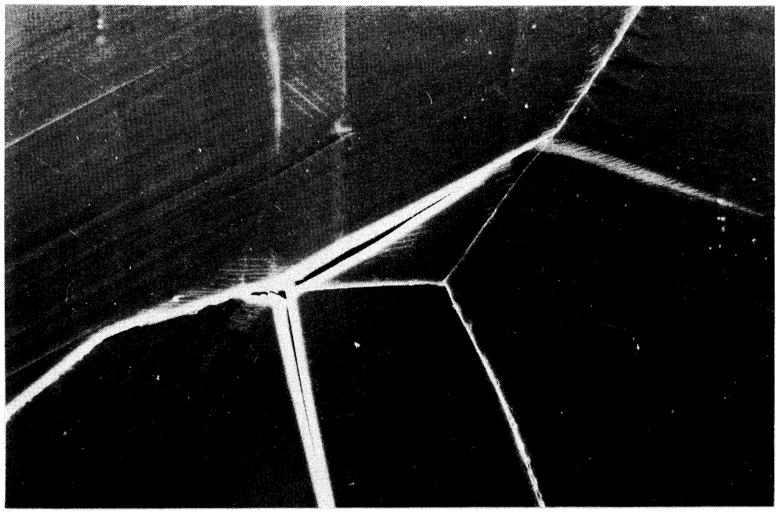

Fig. 6 : Crack through a large angle boundary.