Through-thickness texture gradient of a rolled Al7020 plate

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The rolling texture of aluminium 7000 series has been investigated not very intense. A texture gradient investigation on Al7055-T7751 [1] shows rather strong texture variation over the thickness. A typical aluminium texture after deformation was obtained, the so called β-fiber which spreads in the Euler space from the copper component {112}<111> through the S component {123}<634> to the brass component {011}<211> [2, 3]. Texture investigation after cryo-rolling of Al7075[2] shows the same β-fiber but with a stronger S component [4]. An explanation about the balance between copper, S and brass component is not given.

The as-received of this study was a rolled Al7020 plate having a thickness of 29.5 mm. The nominal alloying elements of Al7020 are 4.4 wt% Zn, 1.25 wt% Mg, 0.32 wt% Fe, 0.31 wt% Mn, 0.14 wt% Zr, 0.1wt% Cu, 0.06wt% Si and 0.01 wt% Ti. The through thickness sample was cut from the plate with dimensions of 7.09 mm along rolling direction (RD), 6.36 mm along transvers direction (TD) and 29.5 mm along normal direction (ND). Pole figure were measured at 0.5 mm, 4 mm, 7.5 mm, 11mm and 14.5 mm (center position) below the surface. The sample orientation at the ω stage was given by RD directed to the detector and by TD perpendicular to the incoming beam. For the pole figure measurement a ω rotation unit was used. The range of ω rotation for complete pole figure measurements goes from -90° to 90°, which has been measured in steps of $\Delta\omega=5°$. In our case, the X-ray energy was approximately 87.7 keV, the wavelength of which was around 0.1422Å. The beam size for the measurement was 0.5×0.5 mm^2, and the sample to detector distance was 1111 mm. Complete Debye-Scherrer rings were collected by Perkin Elmar detector (a kind of fast read-out detector).

After extraction pole figure data from the images, complete ODF analysis (ODF – orientation distribution function) was performed using Al (111), (200) and (220) pole figures up to a degree of series expansion of $L_{max}=23$ [5]. Fig's 1 to 5 show the recalculated Al (111) pole figures for different thickness positions. One can see that the maximum pole density decreases a little from 0.5 mm to 4 mm, and the areas with high pole density at the top of pole figure get a little inside towards the center of the pole figures. From 4 mm to 14.5 mm, the maximum pole density increases gradually, which indicates the texture components get stronger. One is {001}<110>, and the other is {112}<110>. The relative variation of these texture components is presented in figure 6. From surface to the center of the Al 7020 plate the copper, S and brass components become stronger and stronger. First of all one can see that texture sharpness is less near the surface compared the middle part of the Al7020 plate. All three deformation texture components develop similar up to a depth of 11mm inside the plate having stronger orientation densities. While the shear influence on the surface reduces in the depth and can no more detected at 7.5 mm depth. Particular the copper component shows a surprisingly strong orientation density of about 27.9mrd in the middle part.

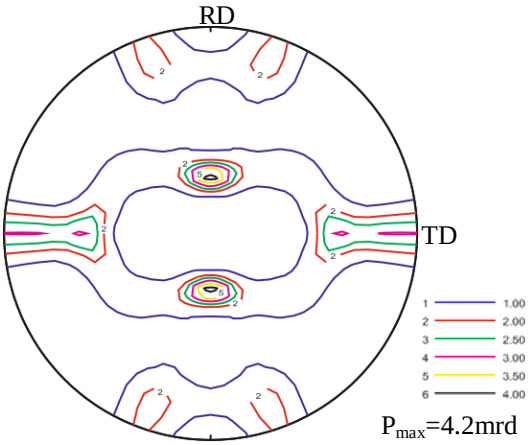

Fig. 1: 111 pole figure of 0.5 mm below the surface

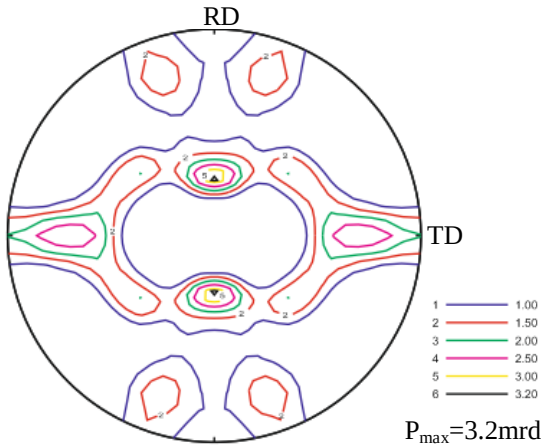

Fig. 2: 111 pole figure of 4 mm below the surface

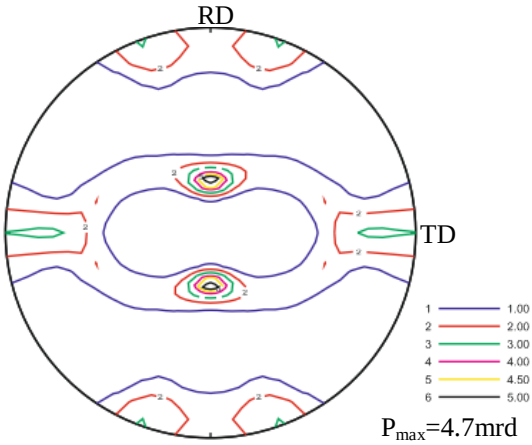

Fig. 3: 111 pole figure of 7.5 mm below the surface

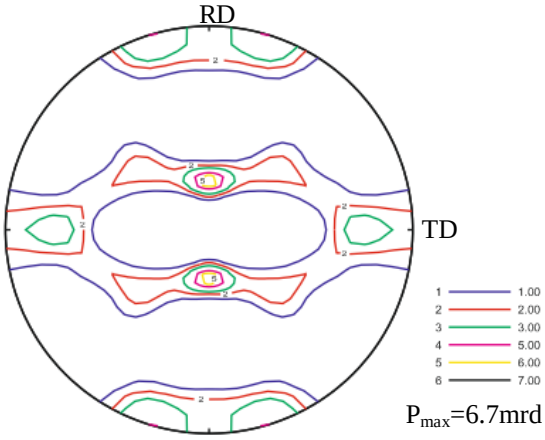

Fig. 4: 111 pole figure of 11 mm below the surface

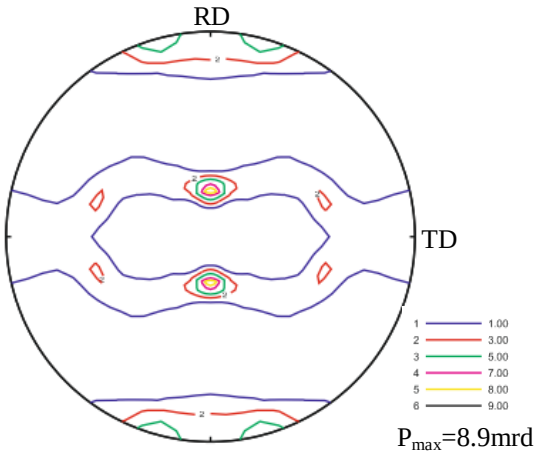

Fig. 5: 111 pole figure of 14.5 mm below the surface

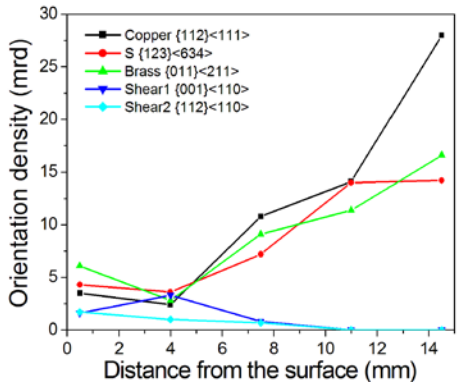

Fig. 6: Changing tendency of ideal components

References

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