

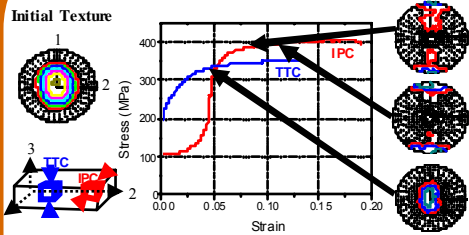
Detwinning in Hexagonal Close-Packed Metals: Example of Magnesium Alloy AZ31 and Pure Zirconium

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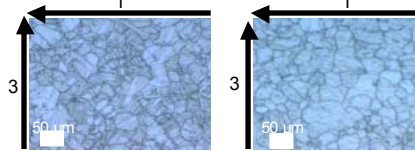
Strain-Path Change Deformation of Mg AZ31

Monotonic Deformation at Room Temperature



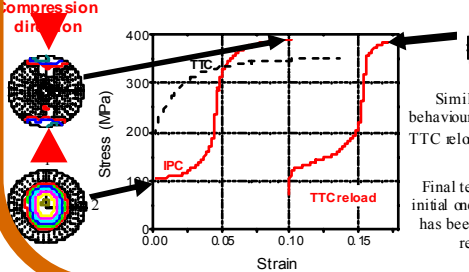
The anisotropy observed during in-plane (IP) and through-thickness (TC) compressions is due to the different deformation modes accommodating strain:
TTC: basal <a> and pyramidal <c+a> slip.
IPC: tensile twinning dominates deformation.
~ 90% of grain volume reorients after 10% compression.

Confirmation of detwinning by optical microscopy



Most twins have disappeared after the change of loading direction. The remaining twins observed can be explained by the strain difference between the two segments of the deformation.

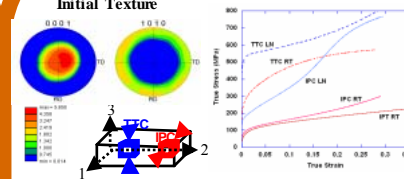
Strain-Path Change: IPC followed by TTC



Similar hardening behaviour observed during TTC reload and monotonic IPC.
Final texture similar to initial one: twinning effect has been reversed upon reloading.

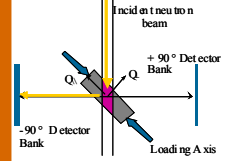
In-Situ Neutron Diffraction Experiments on Pure Zr

Findings from Previous Studies

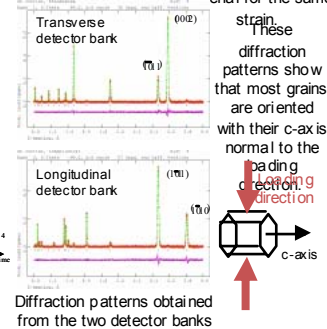


Deformation mechanisms are dependent on loading conditions and temperature. These are present in the deformed material for the same

Experimental Set-Up

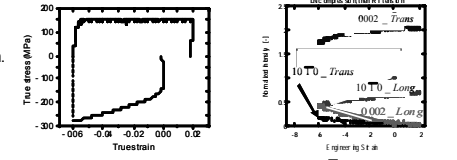


The specimen is subjected to a compression-tension cycle.
1) Compression: liquid nitrogen temperature (LNT).
2) Tension: room temperature (RT).



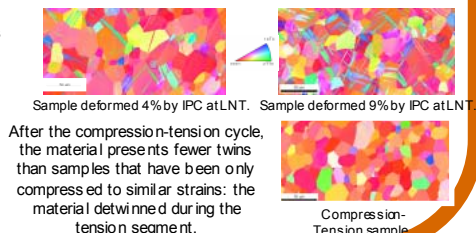
Diffraction patterns obtained from the two detector banks at the start of the experiment.

Results from Reversal Loading



Stress-strain curve obtained during the loading cycle. Normalized (1010) and (0002) peak intensities collected from the transverse and longitudinal detector banks.

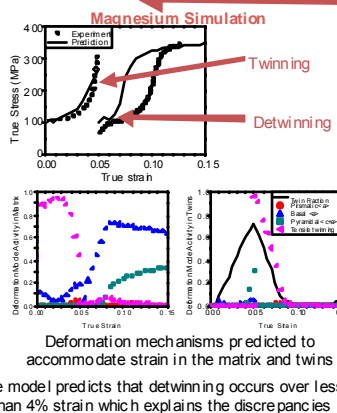
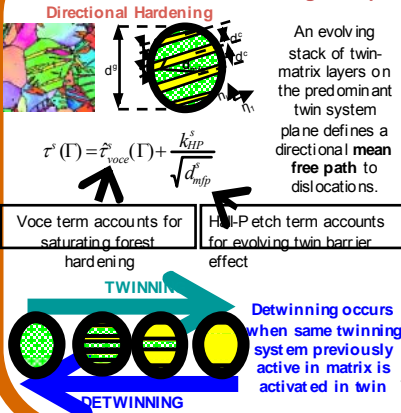
During compression, 8% of the material has twin, reorienting grain domains such as their c-axis is now parallel to the loading direction. During tension, the evolution of the peak intensities shows that fewer grain domains have their c-axis parallel to the loading direction: the twinning influence on the texture has been reversed.



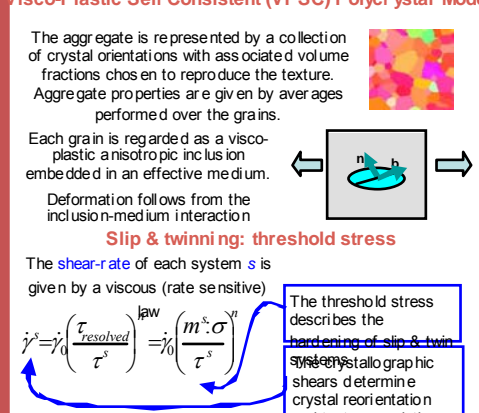
After the compression-tension cycle, the material presents fewer twins than samples that have been only compressed to similar strains: the material detwinned during the tension segment.

Modelling: Polycrystal models provide a link between macroscopic response and microstructure

Twinning: Composite Grain Model



Visco-Plastic Self Consistent (VPSC) Polycrystal Model



Twinning: Predominant Twin Reorientation Scheme

