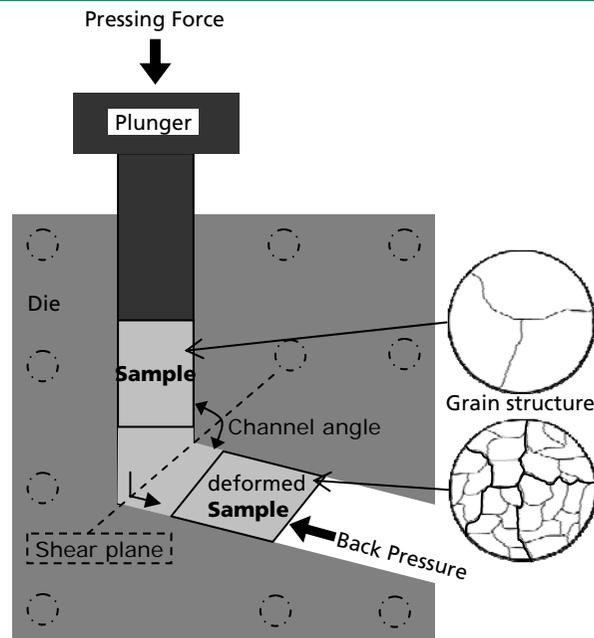

Analysis of Microstructure and Mechanical Behaviour during Equal Channel Angular Pressing of Aluminum for FE-Modelling



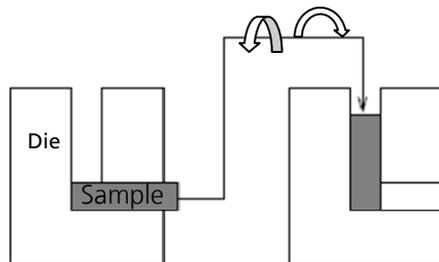
SFB 692 – H A L S



Ultrafine Grain with Equal Channel Angular Pressing



Schematic illustration of the ECAP- Process



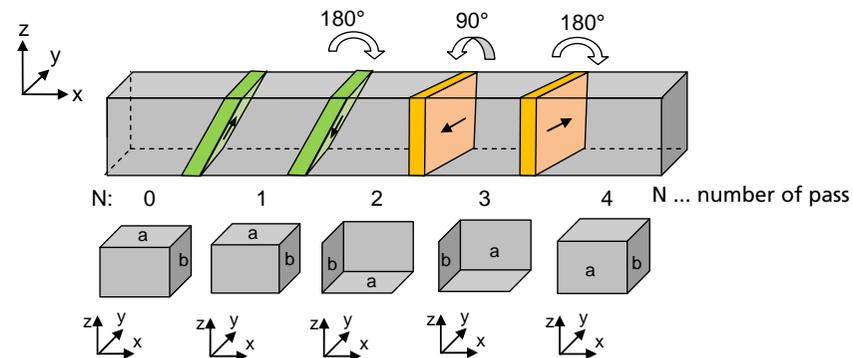
Reference: Habilitationsschrift R.J. Hellmig, TU- Clausthal, 2008;

Setting of ultra fine grained microstructure and homogenization of the microstructure → Realization of multiple different transformation process routes

Basic principle: - pressing a square-profiled sample rod through an angled press channel

- passing channel angle witch represents deformation area
- a strong shear deformation is acting in the sample
- creating dislocations → grain refinement

Variation for adaption process: - degree of channel angle
- number of passes



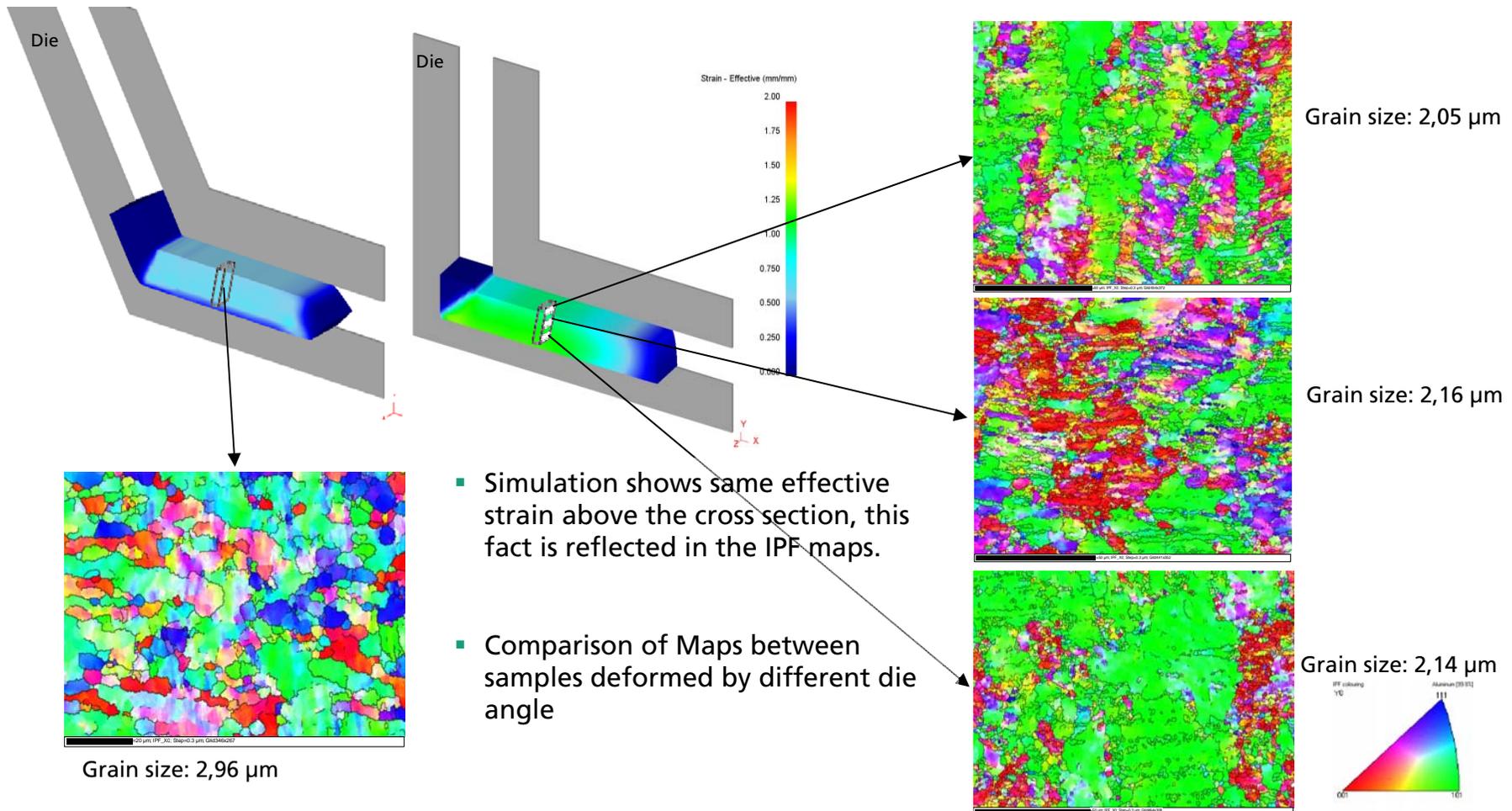
Schematic representation of the shear planes in the sample after each forming process with the ECAP route E

- equal dimensions of input and output channel → possible to add the equivalent true strain per pass

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FE-Modelling and Electron Backscattered Analyse

- Measurement to compare the grain size and the grain orientation in inverse pol figure (IPF) maps through the cross section after one ECAP pass of Al-6082 alloy

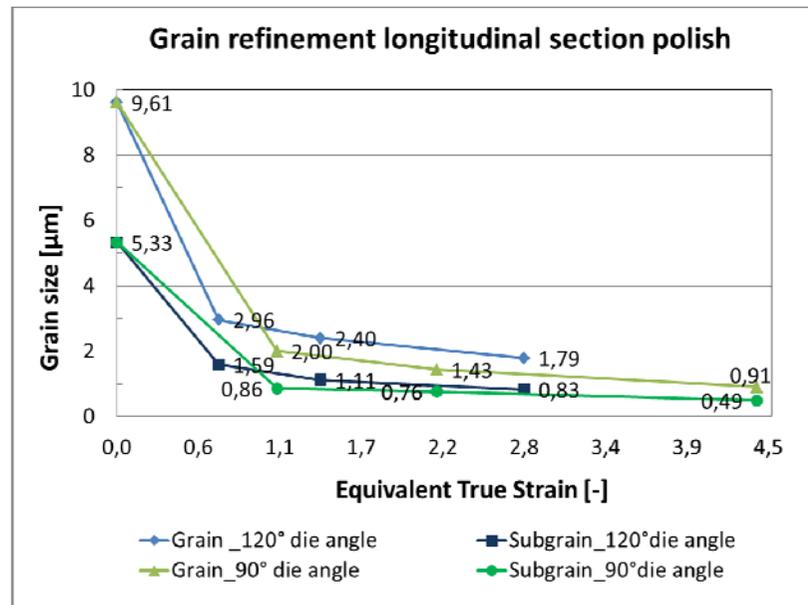


- Simulation shows same effective strain above the cross section, this fact is reflected in the IPF maps.
- Comparison of Maps between samples deformed by different die angle

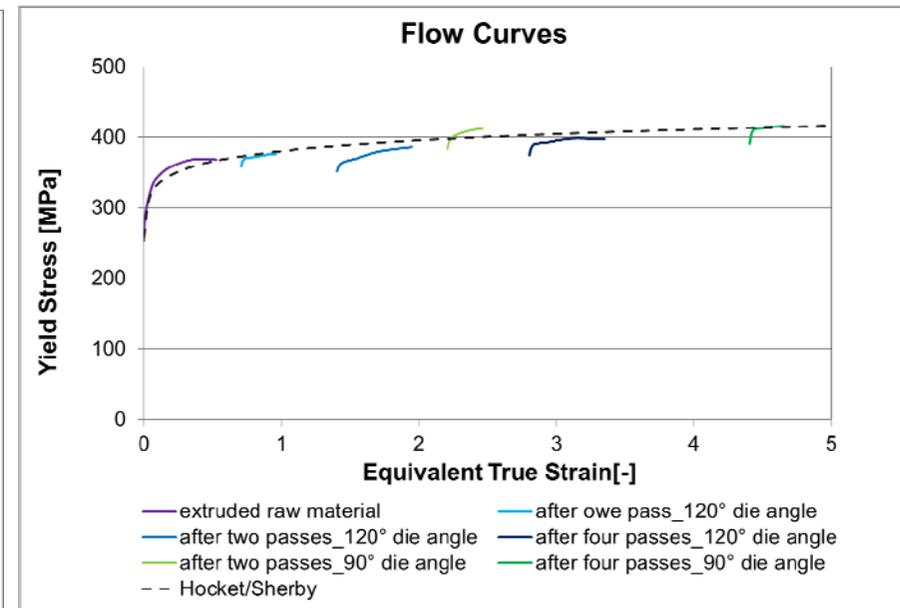
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Analysis of Grain Refinement and Mechanical Behaviour

Grain size development



Characterization of mechanical behaviour: compression test



- Most refinement happens with the first ECAP-pass
- Beyond each follow pass the grain refine more
- In the longitudinal section grain with 900 nm was found, which is 9 % of initial grain size
- Subgrain size go up to 500 nm

- Graph: curves shifted on axis of abscissa by pre-deformation from the ECAP-deformation
- Increase flow stress \Rightarrow after each pass \Rightarrow with growing pre-deformation
- With the Hockett/Sherby approach a approximated flow curve could be created from the separated flow curves.