Super Sheet Metal Stressing

The Stimulating Design Process of Two Novel Straining Devices
Motivation

• Corporate Average Fuel Economy (CAFE) Regulations
• Automotive lightweighting ➞ improved fuel economy

Courtesy of WorldAutoSteel
Automotive Sheet Metals

- Improve the predictability of forming outcomes
- Need for mechanical data on samples under different strain conditions
- Desire for stronger/thinner sheet metals
Cold Rolling ➔ Grain Slipping ➔ Preferred Orientation (Texture) ➔ Mechanical Anisotropy

Transverse Direction (TD) ➔ Rolling Direction (RD)

Cobalt-Nickel Alloy
Simple Testing Procedure

- Load Cell to measure **stress**
- Digital Image Correlation to measure **strain**
Why Neutron Diffraction?

- Limitations of X-Ray Diffraction and load cells
- Ability to measure strain differential of sample
- Size constraints
OCTO-STRAIN

CAPABILITIES:

• Biaxial strain
• Plane strain
• Equibiaxial strain
• Ability to define different strain paths – infinite possibilities!

Scott Jiawei Hallock, Thomas Gnaeupel-Herold

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Design Parameters

- BEAM ENTRY
- 90°
- BEAM EXIT

- XYZ TABLE
- 300mm

- BT-8 Residual Stress Diffractometer

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Modes of Deformation

Equi-biaxial strain

Plane strain

Tension with compression
Grips

Coupling nut

Load Cell

Machined bearing block

High torque stepper gear-motor

Shortened input shaft

Screw jack-to-motor mount

Shaft-to-shaft couple

10 kN screw jack
POSSIBLE BEAM ENTRY PATHS

POSSIBLE BEAM EXIT PATHS
SHEAR DEVICE

CAPABILITIES:

- Simple shear
- Pure shear
- Shear + tension/compression
High torque stepper gear-motor

25 kN screw jack
Coupling nut & load cell
Holding frame
Longitudinal Slider
Translational slider

30mm x 60mm x 1mm sheet metal sample
30mm x 10mm exposed surface
Possible Modes of Deformation

- Pure shear
- Shear with tensile force
- Simple shear
- Translational Slider is fixed
- Fatigue Cycle
Mechanism of Rotation
Driveshaft
Shaft-to-shaft couple
High torque stepper gear-motor
Mount
Ball Bearing
Pinion
x 1
90 degree Rotation
New Areas in Stress-Space

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