Spatially characterization of damage initiation and growth at the micro level

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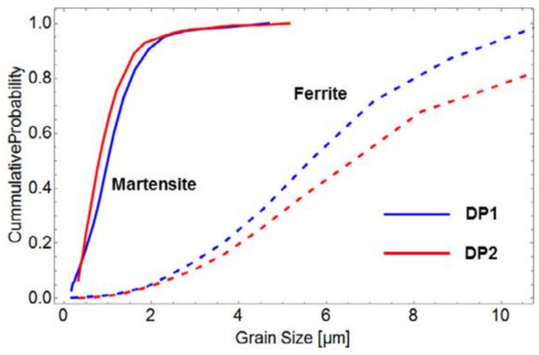
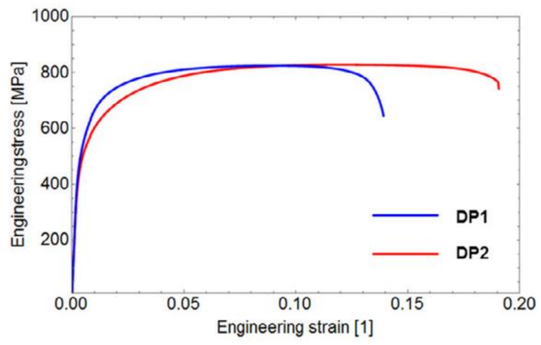
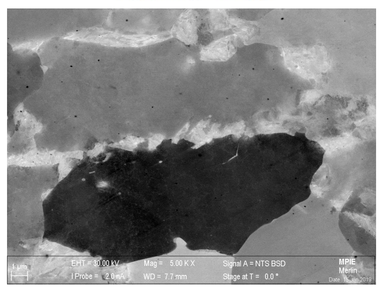
Motivation and objectives





For modeling: mechanical properties of individual phases must be known.
Objectives:

- Quantitative understanding of damage nucleation and growth in DP800.
- Quantitative influence of local (latent) consolidation on damage growth.

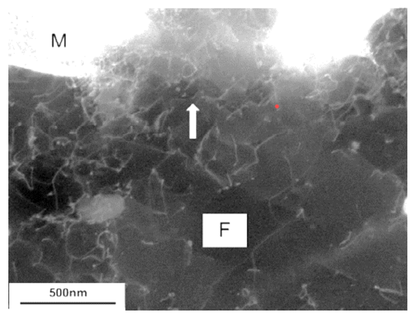


Material: DP800

	C	Si	Mn	P	S	Al	Cr	Mo	Nb	Ti	V	B
DP1	0.131	0.206	1.51	0.008	0.0023	0.03	0.0187	<0.005	0.0188	0.0014	0.0084	<0.001
DP2	0.131	0.194	1.69	0.0088	0.0016	0.038	0.718	0.0035	<0.001	0.0303	0.0027	<0.001

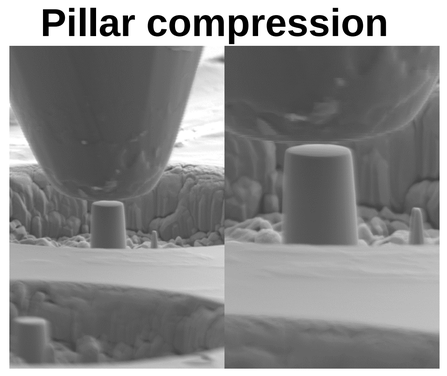
Methodology

ECCI



- Imaging of ferrite in DP800
- Determination of the local dislocation density

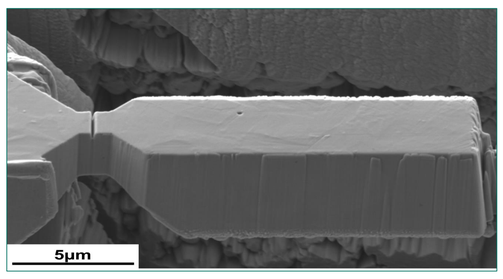
Pillar compression



- Activated slip systems
- Critical resolved shear stress

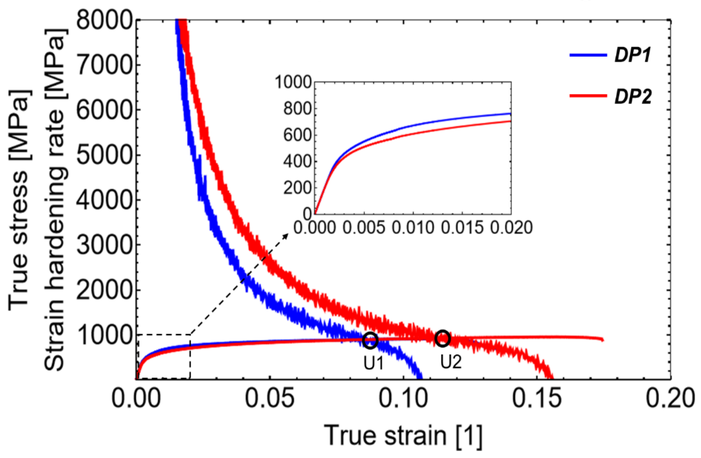
Cantilever bending

- Elastio-Plastic Fracture Mechanics (EPFM)
- Fracture toughness



Does the local (latent) hardening of ferrite suppress damage growth in DP800?

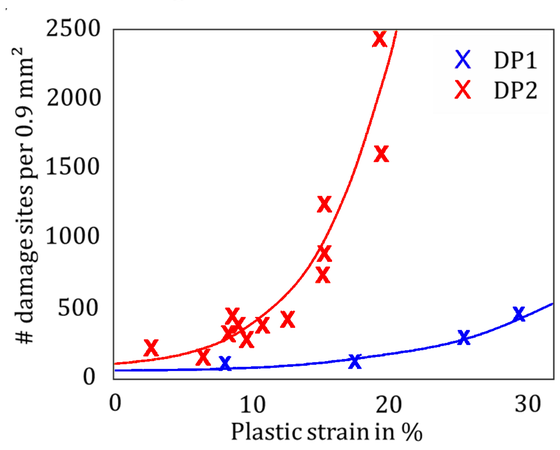
Macroscopic hardening



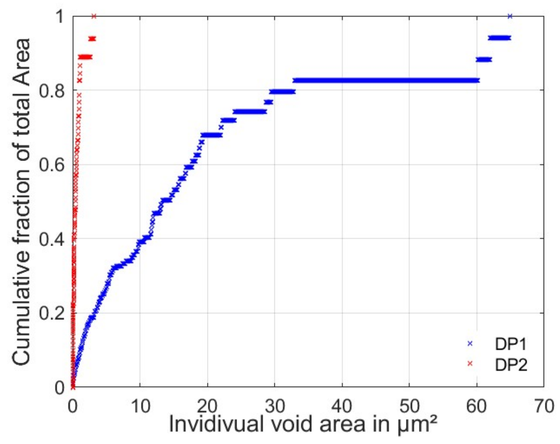
- The tensile strength is 800 MPa for both grades.
- Considère criterion indicates better ductility of DP2.

- However, in terms of pore size, the trend is reversed (DP2 has small pores).
- The ductility of DP2 is better than DP1 despite the high number of damage sites.

Damage evolution

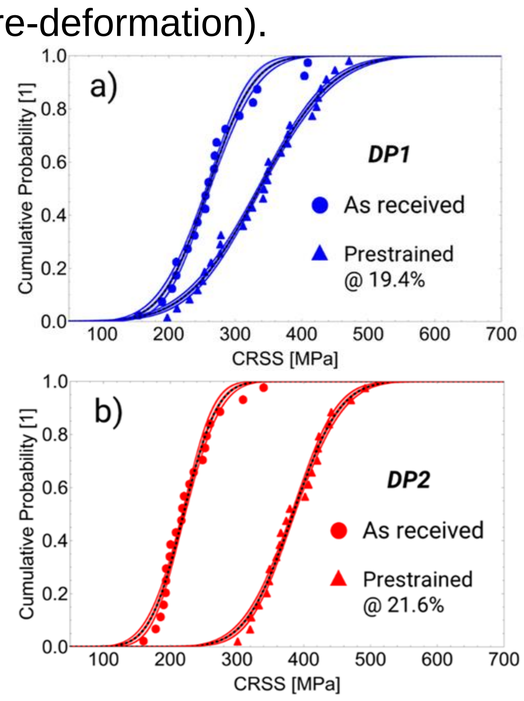


- DP2 has a higher number of damage sites.

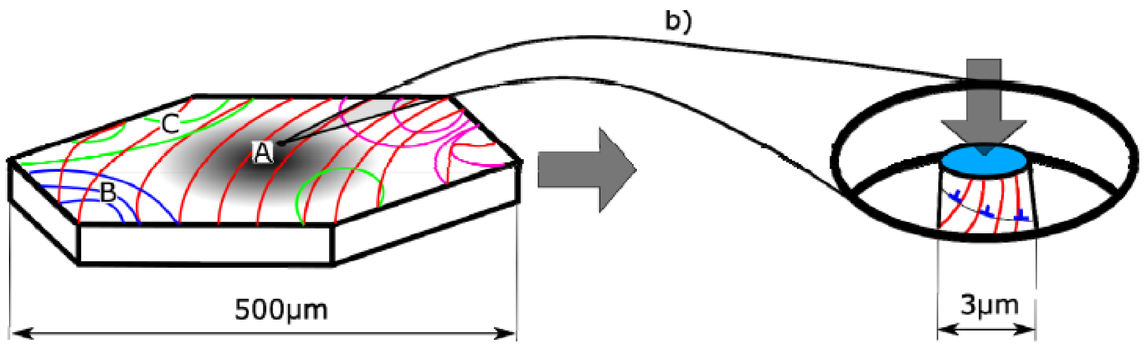


Work hardening of ferrite

- Significant hardening of the ferrite in DP2.
- The statistical variation of the critical shear stress of the ferrite in DP1 is significantly larger than in DP2 (after pre-deformation).



Next steps



- Correlation of dislocation density tensor with strain hardening (latent strain hardening)
- Thermal activation
  - Strain rate
  - Temperature dependence

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