"Greasy" austenite in hard martensite: improving ductility while preserving strength

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Project goal
Advanced high strength steels (AHSS) show good strength and ductility and are widely applied in car industry. Marten- site is often used to improve the strength of AHSS; however, its mechanical behaviour is not well understood. Our project aims to develop a computational framework, capable to predict martensite mechanical and damage behaviour in AHSS.

Martensite in AHSS
Martensite is a metastable iron phase from diffusionless transformation of austenite. It has a well defined internal microstructure (cf. Fig. 2). The smallest units are BCC laths and FCC interlath retained austenite films.

Martensite subgrain model
Laminates of BCC laths and thin FCC austenite, using crystal plasticity. The results show that FCC austenite indeed acts like a “greasy” plane on which stiffer BCC laths slide (Fig. 4).

Experimental validation
The model predicts flow curve, fracture onset (cf. Fig. 6) and roughening pattern of real martensite [4].

Conclusions and future work
Thin austenitic films in martensite act as “greasy” planes; this may explain the observed “apparent” ductility of martensite. Validation on experiments has been done [4]. Damage, fracture and composite deformation mechanism of martensite in multi-phase steels will be further investigated.

References
[1] www.sme.org