# Experimental study and constitutive modelling of sheet steels for industrial applications

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## Abstract :

*Work hardening and fracture behaviour of sheet steels have been investigated by both experimants and numerical simulations. The crystal orientation has significant effects on the work hardening of single crystals, which has been analysed based on crystal plasticity theory. The martensite fracture and decohesion of the martensite/ferrite interfaces play an important role on the fracture bahaviour of dual phase steel.*

*In the course of steel development, heterogeneity at various scales has been elaborately controlled in order to realize superior characteristics at macro scale[1-4]. Since the development of sheet steels for automotive parts shifted its focus from ferritic mild steels to complex high and ultra-high strength steels, the steel industry has required more powerful tools for both the precise analysis of macroscopic behaviour and the development of new materials. In this context, numerical simulations with advanced constitutive modelling have played important roles in forming and crash applications.*
*Firstly, the relationship between the work hardening behaviour at large strains and the evolution of microstructure will be discussed based on the simple shear experiments of ferritic single crystals and crystal plasticity analysis[5]. TEM observations have been performed to study microstructures after shear deformation. The work hardening behaviour depends largely on the crystal orientation, which could be correlated to the type of microstructure via the activity of slip systems.*
*Secondly, fracture behaviour of dual phase steel has been investigated by in-situ tensile tests and finite element simulations. The experiments have shown that the damage is dominated by fracture of the martensite islands and decohesion at the martensite/ferrite interfaces. The FE simulations have shown that the martensite fracture and the interface decohesion have a significant influence on the stress and strain partitioning between ferrite and martensite[6].*
*Effectiveness of the combination of advanced engineering and scientific approaches for industrial applications of sheet steels will be discussed.*

**Keywords : Sheet steel, Work hardening, Fracture, TEM, Crystal plasticity**

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