Dual-Phase steels have long been used for their excellent mechanical properties in terms of strength and ductility balance combined to low costs. The good compromise results from the different properties of the constituent phases, ductile ferrite and hard martensite.

Dual-Phase steels are usually produced with a distribution of equiaxed second phases. The goal of the thesis is to investigate the mechanical performances of Dual-Phase steels with a platelet-like morphology of the second phase. For this purpose, thin sheets with both types of microstructures have been processed, characterized and tested. The platelet morphology exhibits superior cracking resistance as quantified with the Essential Work of Fracture method.

In order to unravel the origin of this excellent cracking resistance, we have investigated the effect of the morphology of the second phases and heterogeneity in the distribution on the plastic behavior, damage evolution and cracking mechanisms.

The effects on plastic behavior at single and multi-grain levels are investigated using a two-scale strategy based on FE calculations performed on unit cells. An important outcome is that, although structural heterogeneities - among others morphology - have a limited impact on effective plastic behavior, they considerably influence the mechanical fields at the micro-scale and thus largely impact damage behavior. The analysis of the damage mechanisms reveals that void nucleation is very much delayed and rare in the platelet case. The data extracted from the elastoplastic analysis are fed into a cellular automaton approach of the damage evolution with the ultimate aim of taking into account the effect of microstructural heterogeneities on fracture strain.