Numerical study on the effect of microstructure on the mechanical behaviour of Dual-Phase steels

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Abstract. Over the last years, the automotive industry faces the challenge of reducing car weight, to improve fuel efficiency and fulfill stringent environmental regulations, whilst either maintaining or improving safety. Driven by these needs, the steel manufacturers have developed the third generation of Advanced High Strength Steels (AHSS), which combine excellent mechanical properties with good formability derived from complex multiphase microstructures. For instance, Dual-Phase steels (DP), consisting of two phases, hard martensitic islands embedded in a soft ferritic matrix, are often used for structural parts of the car body. For the sake of simplicity, in numerical simulations, DP steels are usually considered as homogeneous materials on the macroscopic level. However, experimental studies have shown that the overall response of DP steels at this scale is strongly dependent on microstructural features such as phase volume fractions, grain sizes, morphology, texture, strain localization and so on. Consequently, macroscopic numerical calculations frequently fail to predict the real behaviour of these steels under complex deformation conditions. In this study, three virtual DP steels, with different microstructural features, have been developed by means of a 3D Representative Volume Element (RVE). The RVE models have been subjected to uniaxial tensile tests, which have been performed using ABAQUS®, to study the influence of microstructure on both the overall response of the DP steels and the ductile failure of the ferritic matrix. Simulation results are compared to experimental data.