The main objective of the project is the theoretical and numerical research on damage evolution in multi-phase engineering materials (for ex. austenitic stainless steels partly transformed into martensite).
The constitutive laws will be derived with the use of the hypothesis of total energy equivalence. Great attention will be devoted to proper modeling of coupling between dissipative mechanisms, especially the correlation between the phase transformation and damage evolution will be examined in detail. Moreover, all dissipative phenomena and couplings between them will be physically justified. A homogenization rule will be defined to obtain the average damage measure in a representative volume element in the presence of changing volume fractions of phases in the representative volume. The generalized normality rule will be used to derive kinetic laws of internal state variables. As a part of the project an advanced numerical algorithm will be worked out and numerical procedure will be built in order to implement the constitutive model in FEM program ABAQUS via user subroutine VUMAT and UMAT, with the use of advanced software Mathematica 10, AceGen and AceFem. The validation of the model developed in the project will be based mainly on the experiments available in literature. However, some experiments will be also conducted in the project, in order to identify parameters of the model in room temperature.
As the examples of engineering materials possible to be described with the use of the developed model, austenitic stainless steels of types: 304, 304L, 316, 316L etc., subjected to mechanical loading can be considered. We have chosen austenitic steels because these types of steel are well described in the literature from micromechanical point of view. There are exist, in the literature, many constitutive models of transformation induced plasticity in austenitic steels however there is a lack of constitutive model which would consist of all dissipative phenomena (phase transformation, different type of damage evolution in both phases) and coupling between them.