

Austenitic stainless steels are most commonly used materials in aggressive corrosion environment and elevated temperatures. In most popular grade AISI 304 strain induced martensitic transformation occurs during plastic deformation. During such a transformation austenitic crystal structure transforms into martensitic structure. When chemical composition of steel changes it may be more or less prone to martensite formation during plastic deformation. 301 steel is much more prone to martensite formation while 316L and 310 much less prone to martensite formation in comparison with 304 steel. During strain induced martensite transformation properties of steel change from the initial state: strength and hardness increase, initially non-magnetic (paramagnetic) steel becomes magnetic (ferromagnetic), corrosion resistance is reduced. During heating the steel with strain-induced martensite from as-deformed state the reverse transformation takes place. Hardness and strength decreases and steel becomes nonmagnetic again. Transformation occurs over a wide range of temperatures from approx. 450 to 700°C during equilibrium heating (at very low heating rate). Transformation may proceed by diffusive (nucleation and growth of austenite nuclei) and diffusion less displacive (mechanical change of martensite structure into austenite) mechanism. Thermodynamic factors determining the type of reversion mechanism are still bringing interest. Some researchers indicate that heating rate changes reversion mechanism from diffusive to displacive, other factor may be temperature but others indicate that chemical composition determines reversion mechanism.

The aim of the present research is to find thermodynamic factors for diffusion and displacive reversion mechanism. For this purpose 5 popular austenitic steels were selected. These steels will be deformed at low temperatures using universal testing machine equipped with low temperature chamber and custom made chamber for tensile testing in liquid nitrogen. Deformed steels will be heat treated with at different conditions of temperature and heating rates. Transmission electron microscope as well as transmission electron backscatter diffraction studies allow to determine reversion mechanism. Moreover, the elevated temperature in-situ studies will be performed.

Studies presented in the proposal will extend knowledge in the field of austenitic stainless steels, strain induced martensite and its reverse transformation.