Observations of Retained Austenite Stability and Stress Partitioning in Transformation-Induced Plasticity Steel during In Situ Tensile Testing Using Synchrotron X-ray Diffraction

K.-D. Liss[1], L.C. Zhang[2], U. Garbe[1], J. Almer[3], T. Schambron[2], E.V. Pereloma[2]

[1]*Australian Nuclear Science and Technology Organisation, NSW, Australia*

[2]*School of mechanical, Materials and Mechatronic Engineering, University of Wollongong, NSW, Australia*

[3]*Advanced Photon Source, Argonne, Illinois, USA*

The driving force behind the development of advanced high strength steels for automotive applications is the need for weight reduction due to the environmental concerns. An excellent combination of strength and ductility of transformation-induced plasticity (TRIP) steels makes them attractive candidates for use in car architecture. The presence of retained γ-austenite in an α-ferrite matrix and interaction of all phases present in the complex microstructure is deemed to be responsible for the TRIP steel properties. However, the austenite stability and work hardening behavior in TRIP steel is not well understood. In this work, these issues were investigated in thermomechanically processed Nb-Mo-Al-containing TRIP steel under tensile loading by in-situ high energy X-ray diffraction at 1ID / APS.

Two dimensional diffraction patterns were analyzed radially and azimuthally to deliver information about volume fractions of phases, texture, and stress partitioning. An evolution of the initial rolling texture and lattice strain can be seen under increasing tensile stress. Simultaneously, the γ phase fades away and transforms to martensite. Initial intergranular stress in the longitudinal direction is tensile for α crystals and compressive for γ, which evolves to high tensile stress under the applied load. The analysis by the $\sin^2(\psi)$ method provides more details on the anisotropy of stress.

Keywords: TRIP steel; plastic deformation; phase transformation; texture; residual stress;