Crystallographic characterization of deformation-induced martensite transformation in ultrafine grained metastable austenitic steel

Yuanhong Liu*[1], Nobuhiro Tsuji[1], Gao Si[1], and Park Myeong-Heom[1]

[1]Kyoto University – Japan

Abstract

Ultrafine grained Fe-24Ni-0.3C metastable austenitic steel was deformed to different tensile strains at room temperature and the resulting microstructures were investigated. During the tensile deformation, deformation-induced martensitic transformation from austenite (fcc) to martensite (bcc) occurred. It was confirmed that the deformation-induced martensite exhibited twinned substructure and maintained Kurdjumov-Sachs (K-S) orientation relationship with austenite, with small deviation angles. During the tensile deformation, austenite exhibited a strong texture with 111fcc parallel to the tensile axis (TA) developing, while the intensity of a texture with 001fcc // TA firstly developed and then significantly decreased with tensile strain, although 111 + 001 fiber textures are expected in tensile deformed fcc metals. The result suggested that 001 oriented austenite grains had strong tendency to transform into martensite. Such a crystallographic orientation dependence of mechanical stability of austenite was interpreted by Schmid factor for the shear system of martensitic transformation strain. Additionally, it was found that the number of martensite variants within each prior austenite grain was greatly limited in the ultrafine grained specimen, compared with that transformed in the coarse-grained specimen. A strong 110bcc // TA texture was observed in martensite, indicating the occurrence of variant selection in martensitic transformation. The variant selection was analyzed in terms of accommodation of transformation strain based on the phenomenological theory for martensitic transformation.

Keywords: Deformation, induced martensite transformation, crystallography, variant selection, ultrafine grain, metastable austenitic steel

*Speaker