

ICOMAT | 2017

**INTERNATIONAL CONFERENCE
ON MARTENSITIC TRANSFORMATIONS**

TECHNICAL PROGRAM

WITH ABSTRACTS



1
Structure and Variant Selection of Martensite in Ferrite-martensite Phase Steels Undergone Thermo-mechanical Control Process: *Yan'an; Takuya Ohba¹; Shigekazu Morito¹; Taisuke Hayashi¹; ¹Shimane University*
 Dual-phase microstructure of ferrite and martensite is often produced in low-carbon, low-alloy steel by a thermo-mechanical control process. The effect of deformation in hot rolled prior-austenite on formation of martensite microstructure has not been clarified, because information on the former is rarely available. In this study, the prior-austenite microstructure of two phase steels was reconstructed from martensite orientations measured by electron backscatter diffraction. Owing to development of deformation texture in prior-austenite, variant selection of martensite was observed. The dominance of the variants, whose (011) α' plane is aligned with primary or secondary (111) α' slip planes of austenite. Two kinds of martensite morphology were often found within one prior-austenite grain. Coarse-grained martensite developed inside the austenite grain, whereas fine-grained martensite developed at ferrite-austenite boundaries due to partitioning of carbon. During austempering test, micro-voids tended to nucleate at the boundaries between ferrite and fine-grained martensite.

1
Martensite Transformation Behavior of Delta+Martensite Dual Phase Steels with Low Density Steels: *Xuemin Wang¹; Xiangyu Xu¹; Chengjia Wang¹*
¹Collaborative innovation center of steel technology, University of Science and Technology Beijing
 The influence of martensite on the mechanical properties for low density steels has been investigated with the aid of optical microscope and Scanning electron microscope. The transition electron microscope was also employed to study the effect of NbC and TiC on the grain refinement of delta ferrite and martensite. The experimental results show that during the tempering after the austempered cooling the NbC and TiC precipitated, the NbC and TiC can impede the recrystallization of delta ferrite and refine the delta ferrite grains, and the strength of steels was raised. With the cooling rate increases the martensite transformation from gamma to alpha increases and the strength of steels was improved.

1
Effect of Hot-rolling Direct Quenching and Partitioning Treatment on the Microstructure and Mechanical Properties of a Low Carbon Steel: *Jun Xu¹; Zhenghong Guo¹; Jianfeng Gu²*
¹School of Materials Science and Engineering; ²Institute of Materials Modification and Modeling
 The effects of rolling temperature and following cooling manner on the microstructure and mechanical property of Fe-0.2C-1.5Mn-1.5Si quenching and partitioning steel were investigated. The results show that both the packets and blocks were refined significantly when martensite formed in the recrystallized austenite, but only blocks were refined when martensite formed in the non-recrystallized one. The rolling temperature has little effect on the amount of retained austenite. When the two-step Q&P treatment was replaced by one-step cooling after rolled specimen was quenched to Ms temperature, the amount of retained austenite was decreased dramatically. Tensile and impact properties were investigated. The cooling manner is more critical than rolling temperature in determining mechanical properties. Rolling at a temperature slightly higher than recrystallization temperature plus two-step Q&P treatment is an optimized method to obtain best comprehensive mechanical property by improving both strength and impact toughness without sacrificing plasticity. The related mechanism was discussed briefly.

1
Effect of Austenite Transformation Behavior from Martensite and Its Influence on Retained Austenite and Properties in a Low Carbon 3Mn Steel: *Yan'a Shang¹; Gang Han¹; Zhenjia Xie¹; Lin Xiong¹*
¹University of Science and Technology Beijing
 The influences of intercritical annealing temperature and time on retained austenite and properties were investigated in a 3Mn low carbon low alloy steel. The results showed that multi-phase microstructures consisted of intercritical martensite/bainite, retained austenite and fine dispersed precipitations. The carbon fraction of retained austenite reached a maximum value of 14% after 30 min. Retained austenite was stabilized by controlling reverted austenite transformation and the intercritical partition of Mn, Ni into reverted

austenite. The reverted austenite transformation and partition behaviors of Mn, Ni during intercritical annealing were studied by TEM, STEM and discussed by DICTRA simulation. Due to the combination contribution of multi-phase microstructure, retained austenite and nanoscale precipitation, excellent properties of high yield strength (751 MPa), low yield to tensile ratio (0.77) and ductility (12% and 25% in uniform and total elongation) were achieved at 680°C for 30 min.

3:30 PM Break

Interactions of Phase Transformations and Plasticity: Session 9

Friday PM
 July 14, 2017

Room: Water Tower
 Location: Hyatt Regency Chicago

Session Chair: Steven Mates, National Institute of Standards and Technology

2:00 PM

Correlation between Deformation Texture and Martensitic Transformation in TWIP/TRIP Steels: *Marton Benke¹; Erzsebet Nagy¹; Mate Seps¹; Valeria Mertinger¹*
¹University of Miskolc

In the present manuscript, the texture variation of γ austenite, ϵ martensite and α' martensite phases is investigated in FeMn(Cr) steels exhibiting both TWIP and TRIP behaviour during uniaxial tensile tests. Samples of three steels with varying Cr content were subjected to tensile tests till fracture on different temperatures ranging from room temperature, at which ϵ martensite and γ austenite are stable to 453 K, where only γ austenite was present prior to tensile stressing. In addition, tensile stressing was performed to lower strains at 398 K to obtain partial formation of the martensitic phases. The developed texture of ϵ martensite, α' martensite and γ austenite was examined by means of Electron Backscattered Diffraction (EBSD) orientation mapping and X-ray diffraction pole figure measurements. Correlations between the developed textures and the formation of the martensitic phases are discussed.

2:20 PM

Molecular Dynamics Simulation of Dislocation Induced Phase Transformations: *Hao Chen¹; Liming Xiong¹; Levitas Valery¹*
¹IOWA STATE UNIVERSITY

It is known from experiment that superposition of plastic deformation on high pressure can significantly reduce phase transformation pressure for various materials. Molecular dynamics simulations are performed to investigate the interaction between dislocations and phase transformations in silicon. Dislocation pile up against the grain boundary produces strong stress tensor concentrator and induces phase transformation from the other side of a boundary at pressure significantly lower than under hydrostatic conditions. Also, three most stable $\{110\}$ tilt boundaries are investigated. Results show that phase transformation pressure can be also greatly reduced for all boundaries. The type of phase transformation depends on the interatomic potential used. For the Stillinger-Weber potential, amorphous silicon can be produced. For the Tersoff potential, phase transformation pressure for silicon II can be strongly reduced.

2:40 PM

Constitutive Modeling of Martensitic Transformation in Twinning Induced Plasticity Steels Subjected to Thermomechanical Load: *Rashid Khan¹; Tasneem Pervaz²; Omar Al-Abri²; Sayyad Qamar²*
¹Al Imam University; ²Sultan Qaboos University

Advanced high strength steels (AHSS) cover a vast range of applications where large deformation of a material is desired. Their successful implementation is due to an optimum combination of strength and formability. Twinning induced plasticity (TWIP) steel has excellent strength-cum-formability among AHSS. Stress assisted martensitic transformation found to be principal reason behind an enhancement of these properties. This work is aimed to investigate an elastic-plastic behavior of TWIP steel; undergoes slip, and mechanical twinning subjected to thermomechanical load. Initially, constitutive model is developed through kinematic decomposition of austenite into intermediate configurations. Thermodynamic framework is used to formulate driving potential for twinning.