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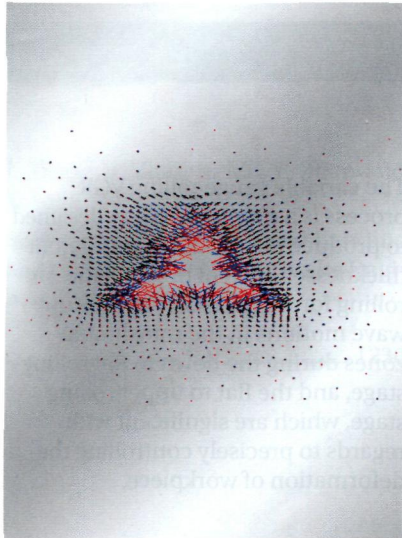
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Processing Technologies

Guest Editors:
A. Kiet Tieu, Hongtao Zhu,
Qiang Zhu

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Cover Photo:

The cover shows a simulated slip traces plot on a (011) oriented single crystal surface after a nanoindentation. More details can be found in the article by M. Liu and co-workers.

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Contents

Editorial

A. Kiet Tieu, H. Zhu, and Q. Zhu

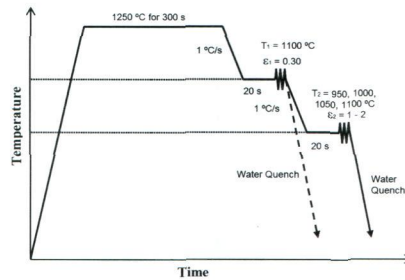
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Full Paper

T. Schambron,* L. Chen, T. Gooch,
A. Deghgan-Manshadi and
E. Pereloma

**Effect of Mo Concentration on
Dynamic Recrystallization Behavior
of Low Carbon Microalloyed Steels**

1191

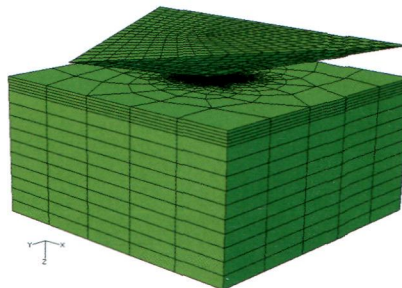


Dynamic recrystallization (DRX) and mechanical properties of microalloyed Nb–Ti-steels with different Mo contents are investigated, and the effects of Mo, deformation temperature and strain rate quantified. The typical signs of DRX are observed over a wide range of deformation conditions, but at higher strain rates and/or lower deformation temperatures, dynamic recovery occurred. It is shown that Mo has a retarding effect on DRX.

M. Liu, C. Lu,* A. K. Tieu and
G. Y. Deng

**Crystal Plasticity Study of the Effect
of the Initial Orientation on the In-
dentation Surface Profile Patterns
and Micro-Textures of Aluminum
Single Crystal**

1196



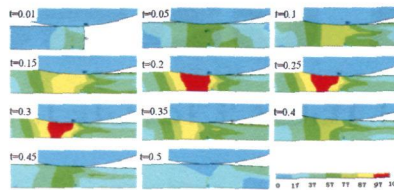
A crystal plasticity finite element method model has been developed to investigate the effect of the initial orientation on the surface profile patterns of aluminum single crystal during nano-indentation. This 3D model has been validated by comparison with experimental observations. The slip traces are analyzed to provide detailed explanations of the anisotropy of the piling-up patterns.

Contents

H.-L. Yu,* K. Tieu, C. Lu, H. Zhu and X.-H. Liu

The Wave Motion of the Rolling Force during Variable Gauge Rolling

1203

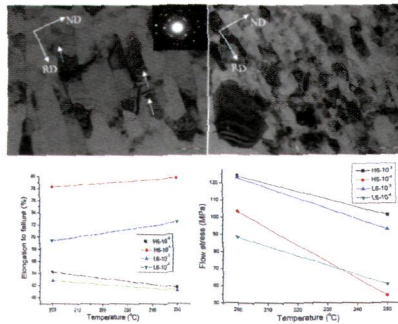


The variable gauge rolling VGR process is a new technology designed to produce flat products of different thicknesses. In VGR process, the rolling force consists of two abrupt wave motions in the transitional stage, and the flat to upper rolling stage, which are significant with regards to precisely controlling the deformation of workpiece.

K. Y. Cheng,* K. Tieu, C. Lu, H. Zhu and L. Pei

Effect of Pre-Heating on the Microstructural Evolution and Super-Plasticity of Al Deformed by Accumulative Roll Bonding

1209



The pre-heating can impair the equiaxed characteristic near the surface of the ARB deformed samples and lead to less grain refinement and more in-grain dislocations. It can also decrease the aspect ratio of the grain structure, which in turn can help to accelerate grain boundary sliding using plastic deformation and then improve the plasticity consequently.

J. Min and J. Lin*

Yield Point Elongation and Localized Deformation Bands in 22MnB5 Steel at Room Temperature

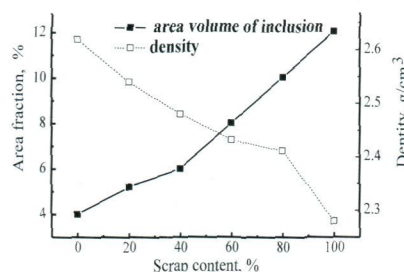
1216



22MnB5 steel sheet exhibits yield point elongation (YPE) in tensile at room temperature, and multiple discontinuously propagating localized deformation bands (LDBs), which are known as Type B Portevin-Le Chatelier (PLC) bands resulting in serrations on stress strain curves, were observed before and during YPE with the aid of digital image correlation technique.

X. Li, Y. Cao, L. He,* Y. Guo and J. Cui
Relationships Between Casting Parameters and Inclusions on the Hydrogen Content in 1050 Alloy

1223



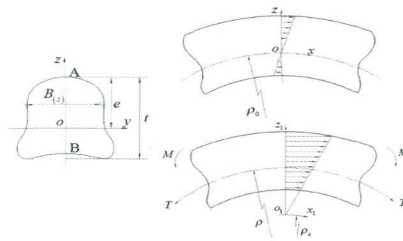
The influences of casting parameters and inclusions on the hydrogen content is very useful in situ aluminum alloy casting procedure to control the hydrogen content. The hot alkaline deep etching method can evaluate the area fraction of the oxide inclusions in aluminum alloy successfully, and provide a convenient and effective method in situ production for inclusion detection.

Contents

J. Zhao,* R. Zhai, R. Ma, P. Zhan and X. Song

Springback Theory of Plane Bending and the Progress of Study on Its Engineering Application

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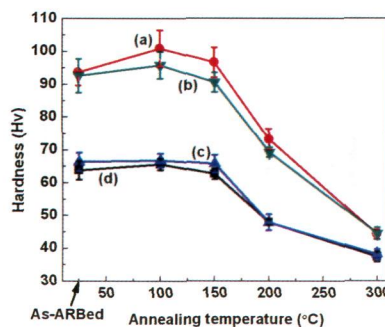


The plane bending geometric constraint equation and the springback equation are established. The theory is applied to several typical techniques on plane bending to predict the springback. The theory not only further enriches the content of the classical theory of elastic-plastic bending, but also provides a theoretical basis and technical support for the springback prediction in engineering problems.

L. Su, C. Lu,* K. Tieu and G. Deng

Annealing Behavior of Accumulative Roll Bonding Processed Aluminum Composites

1241

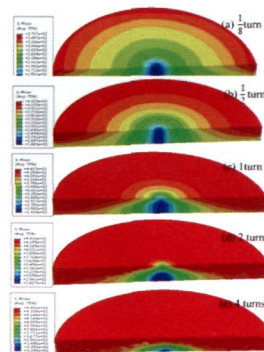


Upon annealing at 100°C for 30 min, hardening by annealing occurs for all the ARB deformed materials, although the increment for AA6061 is larger [curve (a) and (b)] than AA1050 [curve (c) and (d)]. Slight softening is observed after annealing at 150°C. However, the decrement in hardness is not obvious until annealing at 200°C and above.

P. Wei,* C. Lu, K. Tieu, G. Deng, H. Wang and N. Kong

Finite Element Analysis of High Pressure Torsion

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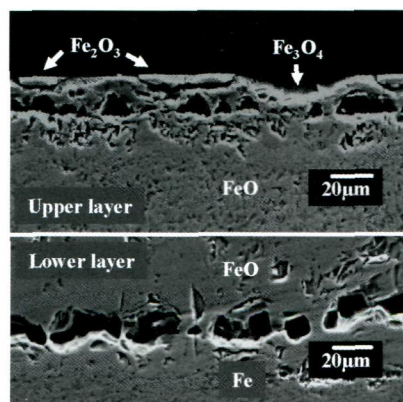


A FEM model with mapping solution method of Abaqus was established and used to investigate the plastic deformation, the stress and equivalent strain distribution and evolution of the HPT process. Inhomogeneous deformation was observed along the radius and axial directions and a homogenous deformation along the whole sample could be anticipated if the strain applied reached a high enough level.

J.-Y. Yun, S.-A. Ha, C.-Y. Kang and J.-P. Wang*

Oxidation Behavior of Low Carbon Steel at Elevated Temperature in Oxygen and Water Vapor

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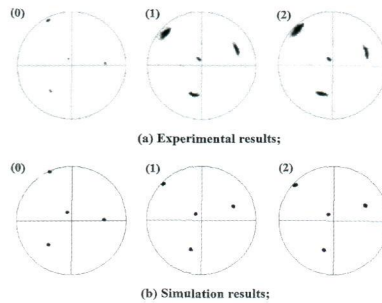
Oxidation behavior of low carbon steel is investigated in oxygen and water vapor using continuous thermogravimetric analysis (TGA). The effect of temperature, oxygen pressure, and water vapor content on the oxidation of the steel is studied. The morphology, composition, and microstructure of oxides formed in moist atmosphere are examined and analyzed by X-ray diffraction (XRD), scanning electron microscope (SEM), and energy dispersive X-ray analysis (EDX).

Contents

G. Deng, A. K. Tieu,* L. Su, C. Lu, H. Zhu, P. Wei and X. Liu

Crystal Plasticity FEM Study on the Influence of Crystallographic Orientation in Copper Single Crystals Subjected to Equal Channel Angular Pressing

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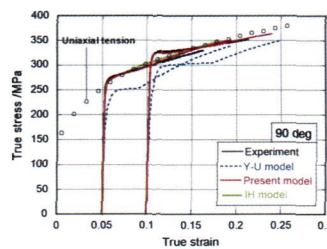


The deformation behavior and orientation development of two copper single crystals with symmetrical orientation to the ideal shear plane during ECAP process have been successfully studied by crystal plasticity finite element method model. The significantly influence on the corner gap formation and morphology of plastic deformation zone has been observed. Simulation results agree well with the earlier published experimental measurements.

T. Uemori,* S. Sumikawa and F. Yoshida

Modeling of Bauschinger Effect During Stress Reversal

1267

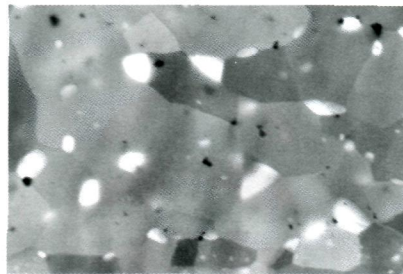


Stress-strain responses of IF sheet metal under uniaxial tension in the 90° after uniaxial pre straining. The Modified Yoshida-Uemori model shows a good agreement with the corresponding experimental stress strain responses.

P. Sellamuthu,* N. Stanford and P. D. Hodgson

Recrystallization Kinetic Behavior of Copper-Bearing Strip Cast Steel

1273

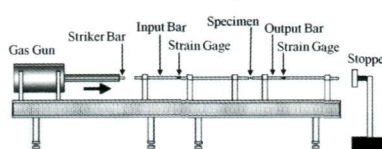


The effects of copper on mechanical, microstructural, and recrystallization behavior are investigated. As-cast microstructure mainly consists of polygonal ferrite and Widmanstätten ferrite. It is found that copper increases strength and hardness by solid solution strengthening and precipitation hardening in as-cast condition. Recrystallization responses are strongly dependent on initial microstructure and Cu content.

C.-T. Peng,* M. D. Callaghan, H. Li, K. Yan, K.-D. Liss, T. D. Ngo, P. A. Mendis and C.-H. Choi

On the Compression Behavior of an Austenitic Fe-18Mn-0.6C-1.5Al Twinning-Induced Plasticity Steel

1281

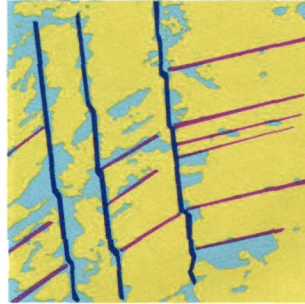


The compression behavior of Fe-18Mn-0.6C-1.5Al steel is investigated in the strain rate range between 1.0×10^{-2} and $6.4 \times 10^3 \text{ s}^{-1}$ at various total strains. The material is characterized through mechanical property determinations, microstructural analyses, and synchrotron high energy X-ray diffraction. The prevailing deformation mechanism is observed to be twinning, which is substantiated by microstructural analyses, as well as phase identification and evolution of crystallographic texture.

Contents

D. Hua,* L. Huaying, W. Zhiqiang, H. Mingli, L. Haoze and X. Qibin
Microstructural Evolution and Deformation Behaviors of Fe–Mn–Al–C Steels with Different Stacking Fault Energies

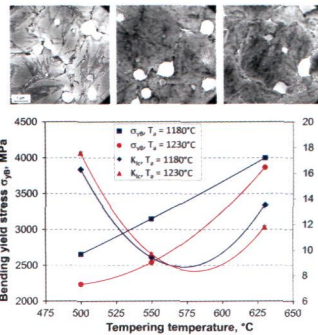
1288



In the present work, Fe–26Mn–xAl–1C steels with different Al concentrations (3, 6, 10, 12%) in a stacking fault energy range of 37–96 mJ m⁻² were investigated. Microstructure observation revealed that deformation mechanisms and strain hardening behaviors were quite different for the steels with different stacking fault energies.

B. Podgornik* and V. Leskovšek
Experimental Evaluation of Tool and High-Speed Steel Properties Using Multi-Functional K_{IC}-Test Specimen

1294



Hardness and fracture toughness are commonly used to optimize vacuum-heat-treatment of the tool. However, there are also other important properties. The best overall appraisal represents combination of fracture toughness, bending, or compression testing and microstructure examination. Paper demonstrates usability of a single K_{IC}-test specimen for determination of a wide range of tool and high-speed steel properties.

H. Li* and D. Mitchell
Microstructural Characterization of P91 Steel in the Virgin, Service Exposed and Post-Service Re-Normalized Conditions

EDITOR'S CHOICE

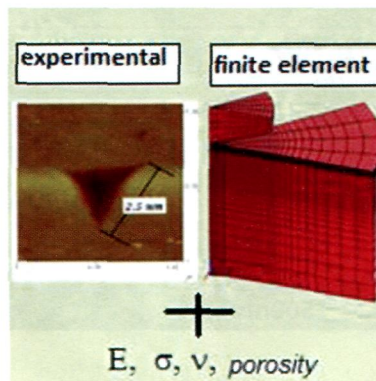
1302



P91 steel has been used in fossil fuel power plants for piping systems with operating temperatures up to 600°C and high pressures in the range of 27 MPa. The use of P91 steel in many plants has now reached the mid-life stage and component failures have been experienced. This paper summarises the microstructural evaluation of ex-serviced P91 steel and the possibility of reclamation through re-normalisation and tempering.

W. F. H. Zamri,* P. B. Kosasih, K. Tieu, H. Zhu and Q. Zhu
Finite Element Modeling of the Nanoindentation of Layers of Porous Oxide on High Speed Steel

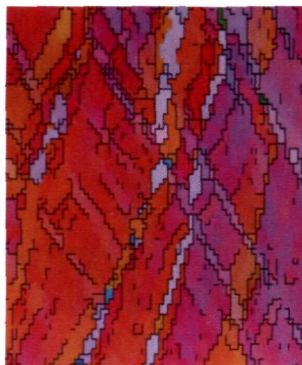
1309



This paper describes a combined FE simulations and nanoindentation experiments to obtain the depth dependent mechanical properties of oxide layers on high speed steels (HSS). The interaction between the mechanical properties and nanoindentation parameters such as the maximum load and unloading slope of the load–displacement curves are established via multiple regression analysis.

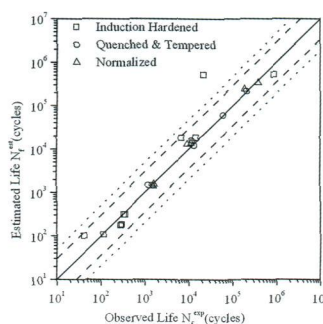
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M. Z. Quadir* and P. R. Munroe
Origin of Copious Recrystallization in Cold Rolled Interstitial Free IF Steels
 _____ 1320



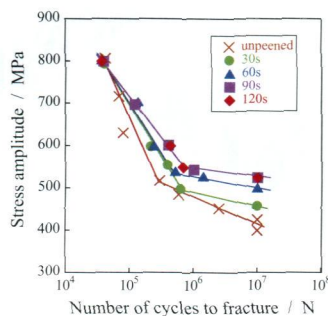
Copious recrystallization occurs in some deform grains during the early stages of annealing in an automobile body making steel. In this article the origin of the event is explained by characterizing the deformation microstructures with electron backscatter diffraction technique. The intersecting micro-shear band locations comprise all necessary elements to operate as fast acting recrystallization sites.

C. Zhao,* X. Li,* F. Wen, X. Gu and B. Wen
Evaluation of Estimation Models for Multiaxial Fatigue Life
 _____ 1325



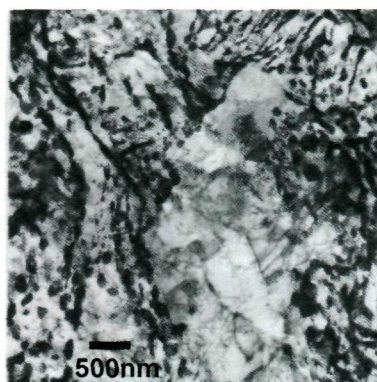
The high cycle fatigue HCF estimation models based on the Crossland criterion, the Papadopoulos criterion, the Findley criterion the Mataka criterion, and the McMiarmid criterion are evaluated by the experimental data of 30NCD16 steel. The low cycle fatigue LCF estimation models based on the Brown and Miller, FS, and SWT parameters are evaluated by the experimental data of 1050 steel.

Y. Harada,* H. Kosaka and M. Ishihara
Effect of Shot Peening on Fatigue Strength of High-Toughness Spring Steel
 _____ 1333



Shot peening using conventional cast steel shots is conducted for the purpose of improving the fatigue characteristics of spring steel. To examine the effect of shot peening on fatigue strength, fatigue tests are carried out in a plane-bending test machine. It is found that the fullcoverage time, 90 s, is required in order to improve the fatigue life.

J. Zrník,* S. V. Dobatkin, L. Kraus and G. Raab
Prior Structure Modification on Grain Refinement and Deformation Behaviour of Medium Carbon Steel Processed by ECAP
 _____ 1340



In order to modify initial microstructure of medium carbon steel AISI 1045 the thermal and thermomechanical (TM) treatments are applied. The final grain refinement of both steel structural states is thereafter completed during ECAP severe plastic deformation (SPD) applying different strain ϵ_{er} . SPD processing resulted in extensive deformation of ferrite grains and cementite lamellae modification. Evaluating results, the course of grains refinement and lamellae modification is more effective in steel, which was preliminary modified by TM.