



Microstructures, mechanical properties and deformation of near-rapidly solidified low-density Fe-20Mn-9Al-1.2C-xCr steels

Jianlei Zhang^a, Conghui Hu^a, Yunhu Zhang^a, Jiehua Li^b, Changjiang Song^{a,*}, Qijie Zhai^a

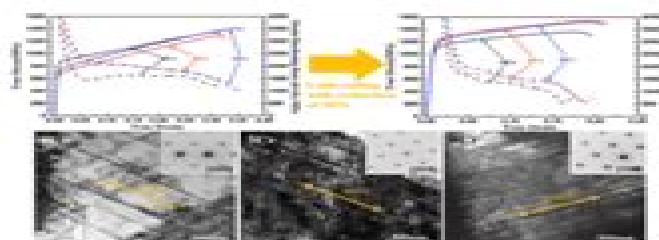
^a Center for Advanced Solidification Technology (CAST), School of Materials Science and Engineering, Shanghai University, Shanghai, 200444, PR China

^b Institute of Casting Research, Montanuniversität Leoben, Leoben, A-8700, Austria

HIGHLIGHTS

- Cr addition increases δ -ferrite content and decreases nano-scale ϵ -carbide content in low-density Fe-20Mn-9Al-1.2C steel.
- The decrease of nano-scale ϵ -carbide promotes generation of the slip bands and increases its strain hardening rate.
- A double (Slip-band and Microband) hardening mechanism is proposed for strain hardening of the low-density steel strips.

GRAPHICAL ABSTRACT



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ABSTRACT

The effects of Cr addition on microstructures, mechanical properties and deformation behavior of near-rapidly solidified low-density Fe-20Mn-9Al-1.2C (wt. %) steel strips were investigated. It was found that Cr addition increased the volume fraction and size of δ -ferrite, and decreased the precipitation of ϵ -carbides in this low-density steel strip. The yield strength of the near-rapidly solidified steel strips was decreased significantly, but the ultimate tensile strength and the total elongation didn't obviously change. However, after cold rolling with 20% reduction, the yield strength and ultimate tensile strength of Cr-containing steel strips were significantly higher than that of the Cr-free steel strip. It was attributed to the fact that the decrease of ϵ -carbides caused by Cr addition facilitated the formation of high-density slip bands during cold rolling deformation. The ultimate tensile strength and total elongation of cold-rolled 3Cr (wt. %) steel strip were 1270 MPa and 21%, respectively. A double (Slip-band and Microband) hardening mechanism was proposed for the strain hardening behavior of the low-density steel strips, and the number of nanoscale ϵ -carbides played a crucial role in the strain hardening rate at the early strain stage.

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1. Introduction

Due to increasingly rigorous demands of energy conservation and emission reduction, the Fe-Mn-Al-C steel with the excellent mechanical properties and low density has extensive attention in the automotive field [1–4]. According to the constitution phase, Fe-Mn-Al-C steel is

* Corresponding author.

E-mail addresses: riverwang@shu.edu.cn, rivercsong@163.com (C. Song).

Mechanical Behavior Of Rapidly Solidified Materials

Stuart M. Lee



Mechanical Behavior Of Rapidly Solidified Materials:

Mechanical Behavior of Rapidly Solidified Materials Shankar M. L. Sastry, 1986 Rapidly Solidified Alloys Liebermann, 1993-05-20 This volume details the principles underlying rapid solidification processing material structure and properties and their applications This practical resource presents a manifold approach to both amorphous and crystalline rapidly solidified metallic alloys Written by over 30 internationally acclaimed specialists in their respective fields Rapidly Solidified Alloys surveys nucleation and growth studies in undercooled melts examines various processes for the production of rapidly solidified alloys discusses the compaction of amorphous alloys describes surface remelting treatments for the rapid solidification of surface layers and the resultant improved workpiece properties covers the closely related topics of structural relaxation atomic transport and other thermally induced processes demonstrates microstructure property relationships in rapidly quenched crystalline alloy systems and their beneficial effects in applications and elucidates the basic engineering and applications oriented magnetic properties of amorphous alloys Furnishing more than 2300 literature citations for further study of specific subjects Rapidly Solidified Alloys is intended for materials mechanical product and civil engineers metallurgists magneticians physicists physical chemists and graduate students in these disciplines **Mechanical Behavior of Rapidly Solidified Materials** Metallurgical Society of AIME Staff, *Rapidly Solidified Materials* Peter W. Lee, Robert S. Carbonara, 1985 *Rapid Solidification Technology* T.S. Sudarshan, T.S. Srivatsan, 1993-12-20 Rapid solidification processing results in increased strength and fracture and fatigue resistance of alloys with concurrent improvements in mechanical physical and chemical properties This volume provides a systematic examination of this technology including metallurgical aspects processing methods alloy design and applications Each chapter was prepared by a specialist for this volume The text is well illustrated with more than 400 micrographs and schematics More than 75 tables provide important reference data *NASA Technical Memorandum*, 1987 **Metallurgical Applications of Shock-Wave and High-Strain Rate Phenomena** Lawrence E. Murr, Karl P. Staudhammer, Marc A. Meyers, 2024-11-01 This book examines the explosive and related technologies in the context of metallurgical and materials processing and fabrication It is a record of the international exchange of information on the metallurgical and other material effects of shock wave and high strain rate phenomena **Mechanical Behavior of Metals at Extremely High Strain Rates** Jaroslav Buchar, 1986 **Microgravity Science and Applications Program Tasks**, 1987 *Hot Deformation and Processing of Aluminum Alloys* Hugh J. McQueen, Stefano Spigarelli, Michael E. Kassner, Enrico Evangelista, 2016-04-19 A comprehensive treatise on the hot working of aluminum and its alloys Hot Deformation and Processing of Aluminum Alloys details the possible microstructural developments that can occur with hot deformation of various alloys as well as the kind of mechanical properties that can be anticipated The authors take great care to explain and differenti **Cryocoolers 9** Ronald G. Jr. Ross, 2012-12-06 Proceedings of the 9th International Conference held in Waterville Valley New Hampshire June 25 27 1996

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Table of Contents Mechanical Behavior Of Rapidly Solidified Materials

1. Understanding the eBook Mechanical Behavior Of Rapidly Solidified Materials
 - The Rise of Digital Reading Mechanical Behavior Of Rapidly Solidified Materials
 - Advantages of eBooks Over Traditional Books
2. Identifying Mechanical Behavior Of Rapidly Solidified Materials
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Mechanical Behavior Of Rapidly Solidified Materials
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mechanical Behavior Of Rapidly Solidified Materials
 - Personalized Recommendations
 - Mechanical Behavior Of Rapidly Solidified Materials User Reviews and Ratings
 - Mechanical Behavior Of Rapidly Solidified Materials and Bestseller Lists
5. Accessing Mechanical Behavior Of Rapidly Solidified Materials Free and Paid eBooks
 - Mechanical Behavior Of Rapidly Solidified Materials Public Domain eBooks
 - Mechanical Behavior Of Rapidly Solidified Materials eBook Subscription Services
 - Mechanical Behavior Of Rapidly Solidified Materials Budget-Friendly Options

6. Navigating Mechanical Behavior Of Rapidly Solidified Materials eBook Formats
 - ePub, PDF, MOBI, and More
 - Mechanical Behavior Of Rapidly Solidified Materials Compatibility with Devices
 - Mechanical Behavior Of Rapidly Solidified Materials Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mechanical Behavior Of Rapidly Solidified Materials
 - Highlighting and Note-Taking Mechanical Behavior Of Rapidly Solidified Materials
 - Interactive Elements Mechanical Behavior Of Rapidly Solidified Materials
8. Staying Engaged with Mechanical Behavior Of Rapidly Solidified Materials
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mechanical Behavior Of Rapidly Solidified Materials
9. Balancing eBooks and Physical Books Mechanical Behavior Of Rapidly Solidified Materials
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mechanical Behavior Of Rapidly Solidified Materials
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Mechanical Behavior Of Rapidly Solidified Materials
 - Setting Reading Goals Mechanical Behavior Of Rapidly Solidified Materials
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mechanical Behavior Of Rapidly Solidified Materials
 - Fact-Checking eBook Content of Mechanical Behavior Of Rapidly Solidified Materials
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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