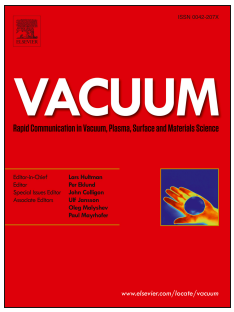
Accepted Manuscript



Effects of temperature and strain rate on the dynamic recrystallization of a medium-high-carbon high-silicon bainitic steel during hot deformation

Ying Han, Shun Yan, Baoguo Yin, Huijun Li, Xu Ran

PII: S0042-207X(17)31252-6

DOI: 10.1016/j.vacuum.2017.11.007

Reference: VAC 7675

To appear in: *Vacuum*

Received Date: 12 September 2017

Revised Date: 6 November 2017

Accepted Date: 7 November 2017

Please cite this article as: Han Y, Yan S, Yin B, Li H, Ran X, Effects of temperature and strain rate on the dynamic recrystallization of a medium-high-carbon high-silicon bainitic steel during hot deformation, *Vacuum* (2017), doi: 10.1016/j.vacuum.2017.11.007.

Effects of temperature and strain rate on the dynamic recrystallization of a medium-high-carbon high-silicon bainitic steel during hot deformation

Ying Han [1,2], Shun Yan [1], Baoguo Yin [1], Huijun Li [2], Xu Ran [1*]
[1]Key Laboratory of Advanced Structural Materials, Ministry of Education, Changchun University of Technology, Changchun 130012, PR China;
[2]School of Materials Science & Engineering, Tianjin University, Tianjin 300354, PR China

Abstract

Isothermal compressive deformation tests for 0.58C–1.89Mn–1.57Si–0.88Cr (wt.%) bainitic steel were conducted on a Gleeble 1500D thermo-simulator machine at temperatures ranging from 950°C to 1150°C and strain rates ranging from 0.005 s^{-1} to 5 s^{-1}. The flow characteristics, particularly dynamic recrystallization (DRX) behavior, were investigated. The results showed that the deformation temperature and strain rate have significant effects on the DRX behavior of the studied steel. The grain boundaries through local bulging provide the nucleation cites for DRX. The high temperature and low strain rate can speed up the progress of DRX and the growth of recrystallized grains. The hot deformation activation energy is estimated to be 317.389 kJ/mol, and the critical conditions for initiating DRX are identified by using the Zener-Hollomon parameter. Based on the microstructure observation and the data of flow curves, the DRX models of grain size and kinetics are developed; these models yield satisfactory precision and reliability.

Keywords

bainitic steel; hot deformation; Zener-Hollomon parameter; dynamic recrystallization

1 Introduction

Silicon-rich bainitic steels, as a new class of super-bainitic steels, have been attracting increased interest for many structural applications (i.e., chassis, bearings, and plate armor) because of their ultra-high strength and good toughness [1–3]. A high

*Correspondence: Tel.: +86-133-4157-6601; Fax: +86-0431-85716396
Email: hanying_118@sina.com; ranxu@ccut.edu.cn