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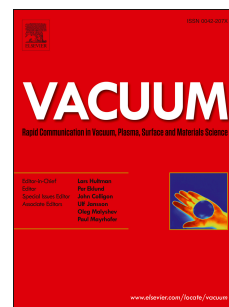
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Effects of temperature and strain rate on the dynamic recrystallization of a medium-high-carbon high-silicon bainitic steel during hot deformation

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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 sites 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

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