Document type
Article

Source type
Journal

ISSN
19961944

DOI
10.3390/ma14102639

Materials • Open Access • Volume 14, Issue 10 • 2 May 2021 • Article number 2639

Determination of non - recrystallization temperature for niobium microalloyed steel

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Abstract

In the present investigation, the non - recrystallization temperature (T_{NR}) of niobium - microalloyed steel is determined to plan rolling schedules for obtaining the desired properties of steel . The value of T_{NR} is based on both alloying elements and deformation parameters. In the literature, T_{NR} equations have been developed and utilized. However, each equation has certain limitations which constrain its applicability. This study was completed using laboratory-grade low-carbon Nb- microalloyed steels designed to meet the API X-70 specification. Nb- microalloyed steel is processed by the melting and casting process, and the composition is found by optical emission spectroscopy (OES). Multiple-hit deformation tests were carried out on a Gleeble® 3500 system in the standard pocket-jaw configuration to determine T_{NR}. Cuboidal specimens (10 (L) × 20 (W) × 20 (T) mm^3) were taken for compression test (multiple-hit deformation tests) in gleeble. Microstructure evolutions were carried out by using OM (optical microscopy) and SEM (scanning electron microscopy). The value of T_{NR} determined for 0.1 wt.% niobium bearing microalloyed steel is ~ 951°C. Nb- microalloyed steel rolled at T_{NR} produce partially recrystallized grain with ferrite nucleation. Hence, to verify the TNR value, a rolling process is applied with the finishing rolling temperature near TNR (~951°C). The microstructure is also revealed in the pancake shape, which confirms T_{NR}. © 2021 by the authors. Licensee MDPI, Basel, Switzerland.

Author keywords

Microalloy; Microstructure; Niobium ; Recrystallization temperature ; Temperature

Engineering controlled terms

Alloying elements; Compression testing; Deformation; Low carbon steel ; Microalloying; Microstructure; Niobium alloys; Niobium metallography; Optical emission spectroscopy; Recrystallization (metallurgy); Scanning electron microscopy; Steel metallography

Engineering uncontrolled terms

Deformation parameter; Micro-structure evolutions; Nb microalloyed steels; Niobium bearing microalloyed steel ; Niobium microalloyed steel ; Optical emission spectroscopies (OES); Recrystallization temperatures;

Recrystallized grains

Engineering main heading

Microalloyed steel

Funding sponsor	Funding number	Acronym
Research Creativity and Management Office		
Universiti Sains Malaysia		
Universiti Teknologi Petronas	015MD0-052	UTP

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Funding text

The authors would like to acknowledge the RU Top-Down research grant (1001/PAERO/870052) provided by the Research Creativity and Management Office, Universiti Saint Malaysia to support this research. In addition, the authors would like to acknowledge Universiti Teknologi Petronas RCMO and its Industrial Grant (015MD0-052).

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