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Data Article

Data related to dislocation density-based constitutive modeling of the tensile behavior of lath martensitic press hardening steel

Kyoung-Rae Jo [a], Eun-Jung Seo [a], Dimas Hand Sulistiyo [a], Jin-Kyung Kim [a,*], Seong-Woo Kim [b], Bruno C. De Cooman [a]

[a] Graduate Institute of Ferrous Technology, Pohang University of Science and Technology, Pohang 37673, Republic of Korea
[b] POSCO Technical Research Laboratories, Gwangyang 57807, Republic of Korea

A R T I C L E I N F O

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A B S T R A C T

The data presented in this article are related to the research article entitled "On the plasticity mechanisms of lath martensitic steel" (Jo et al., 2017) [1]. The strain hardening behavior during tensile deformation of a lath martensitic press hardening steel was described using a dislocation density-based constitutive model. The Kubin–Estrin model was used to describe strain hardening of the material from the evolution of coupled dislocation densities of mobile and immobile forest dislocation. The data presented provide insight into the complex deformation behavior of lath martensitic steel.

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* Corresponding author.
E-mail address: intobe@postech.ac.kr (J.-K. Kim).

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Specifications Table

Subject area	*Materials Science*
More specific subject area	*Physical Metallurgy*
Type of data	*Table, Graphs*
How data was acquired	*Constitutive modeling*
Data format	*Raw and analyzed*
Experimental factors	*A cold-rolled 0.35 wt% C press hardening steel (PHS) was used. The tensile samples were austenitized and then quenched to room temperature in order to make fully martensitic microstructure.*
Experimental features	*The Kubin–Estrin model was used to describe the strain hardening behavior during tensile deformation of PHS from the evolution of the coupled densities of mobile dislocations, ρm, and immobile forest dislocations, ρf.*
Data source location	*Graduate Institute of Ferrous Technology, Pohang University of Science and Technology, Pohang, Korea*
Data accessibility	*The data are available with this article.*

Value of the data

- The data can be used to explain strain hardening behavior of lath martensitic steel.
- The data provide a foundation for more accurate modeling of strain hardening behavior of lath martensitic steel.
- The data may be compared with the tensile behavior of other lath martensitic steels.

1. Data

The strain hardening behavior during tensile deformation of a lath martensitic press hardening steel (PHS) was described using a dislocation density-based constitutive model. The Kubin–Estrin model was used to describe strain hardening of the material from the evolution of coupled dislocation densities of mobile and immobile forest dislocation. Two models with different parameter values are presented, and the results include stress–strain curves and the evolution of mobile and forest dislocation density with strain, calculated by the models. The parameter values used for modeling are presented in a table.

2. Experimental design, materials and methods

A cold-rolled 0.35 wt% C PHS was used [1]. The tensile samples were austenitized and then quenched to room temperature in order to make fully martensitic microstructure. The specimens were tested in tension in an electromechanical universal testing machine using a strain rate of 10^{-3} s^{-1}. The experimental true stress-strain curve of the as-quenched PHS is shown in Fig. 1.

The conventional yield strength (YS), i.e. 0.2% offset stress, of lath martensitic steel is generally high as compared to other steels. However, micro-yielding can occur at stresses lower than the 0.2% offset stress. Due to the absence of a clear yield point in the flow curve of lath martensitic steel, the 0.2% offset YS is considered as the YS of the material in the present work. The equation proposed by Galindo-Nava and Rivera-Diaz-del-Castillo was used to calculate the YS of the PHS [2]:

$$\sigma_{\text{Martensite}} = \sigma_0 + \frac{300}{\sqrt{d_{\text{block}}}} + 0.25MGb\sqrt{\rho} \tag{1}$$