Relationship between dislocation density and energy storage

How does stored energy relate to dislocation density?
The Eq. (18) relating the stored energy to the dislocation density allows for a transparent physical interpretation: the stored energy refers to the difference between the energies of the crystal deformed and the initial state characterised solely by the dislocation densities ? and ? 0, respectively.

Does dislocation spacing affect configurational energy density?
The configurational energy density is found not only to depend on the dislocation spacingbut also to be related to the local stress states. Low source densities lead to higher (positive) configurational energy densities.

What is the relationship between free energy and dislocation densities?
This result proves that the free energy in the simulations is almost exclusively linked to dislocations, either stored in the dislocation cores itself or in elastic strain caused by the far reaching elastic elds of dislocations. In the following, the relation of these energies to the dislocation densities is discussed in detail.

Which dislocation densities are used for stored energy computations?
For stored energy computations,dislocation densities from approach Cwere used. Since the part of Eq. (30) that is nonlinear in dislocation density is only logarithmic,stored energy predictions from B and C,similarly to the mean dislocation density,only barely differ.

What is dislocation energy?
(a) The free energygiven by the summation of elastic stored energy and the energy associated with the dislocations. Part of the free energy is dissipated from the system when one dipole moves out of the crystal. (b) Decomposition of the energy associated with dislocations into dislocation line energy and configurational energy.

How does dislocation density affect material strength?
Results show that material strength displays a decreasing regime (strain rate hardening) and then increasing regime(classical forest hardening) as the dislocation density increases. Accordingly,the strength displays universally,as the strain rate increases,a strain rate-independent regime followed by a strain rate hardening regime.

In this study, the contribution of deformation twins to the strength of high-Mn steel was quantitatively evaluated through experiments and explained through stacking fault ...

We show that rolling and low-temperature tempering produced a high dislocation density in steel, also enabling a large ductility. In addition to ...

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This work reveals the non-equivalence contribution of geometrically necessary dislocation (GND) and statistically stored dislocation (SSD) to work hardening of the dual ...

Grain and precipitate morphologies, orientations, and distributions in precipitation hardened nickel alloy 718 are directly affected by material processing, thermal and ...

The dislocation density distributions can be described well with a log-normal function. These data sets are very rich and provide ample data such that quantitative statistical ...

One solution to this trade-off relationship lies in a strengthening strategy that not only obstructs dislocation motion, but also provides extra dislocation storage capability.

A higher length scale crystal plasticity stored energy density has recently been introduced which attempts to capture local dislocation configurational energy density as an ...

Extending the storage-recovery model, we propose a new strengthening model, premised on detailed evolution laws for both mobile and ...

The results obtained from both the full sample sizes as well as from smaller sub-volumes strongly indicate a linear relation between the total dislocation density of self-assembled dislocation ...

Emphasizing the relationship between dislocation density and material properties empowers engineers to innovate more effectively. A nuanced approach to ...

Conversely, within the laser scan track interiors, a majority of grains display higher GOS values, signifying a higher dislocation density and amount of stored energy ...

Comparison of dislocation density, twin fault probability, and stacking fault energy between CrCoNi and CrCoNiFe medium entropy alloys deformed at 293 and 140K ...

Since the linear relationship between two Nye tensor components and densities of geometrically necessary dislocations is usually under-determined, the total density of geometrically ...

An analytical relationship between material strength, dislocation density, strain rate and dislocation mobility is proposed, which agrees well with current simulations and ...

The mechanical behavior of most metals in engineering applications is dominated by the grain size. Physics-based models of the interaction between dislocations and ...

The dislocation density, ?d, a type of concentration, is measured by counting the number of dislocation lines

that thread a unit area of surface (i.e., #/m 2); ? d is also defined in terms of ...

The effects of grain size, source density, and misorientations on the dislocation configurational energy area density are investigated using two-dimensional discrete dislocation ...

An analytical relationship between material strength, dislocation density, strain rate and dislocation mobility is proposed, which agrees well with current simulations and published ...

Cellular patterns formed by self-organization of dislocations are a most conspicuous feature of dislocation microstructure evolution during plastic deformation. To ...

Metal additive manufacturing (AM) has the potential to tailor the mechanical performance of materials. Due to the complex thermal history and unique microstructure, AM ...

The relationship between Nye"s tensor ?ij and the GND density ?s is given by Eq. (1): (1) ? i j = ? s = 1 S max ? s b i s l j s where bs is the Burgers vector and ls denotes the unit ...

The configurational energy area density displays a strong size dependence, similar to the stress response. Two sets of materials are considered, with low and high ...

In contrast, the dislocation absorption and emission events, as well as the evolution of resolved shear stress and dislocation density, do not depend on the GB ...

However, it is currently unclear which of dislocation transmission and dislocation source activation plays the dominant role in regulating dislocation-GB interaction. To study the ...

In this paper, based on experimental and simulation results, the structure of boundaries (the grain boundary, the dislocation boundary, the twin boundary ...

The Taylor equation provides a relationship between yield stress and strain. The semi-empirical Kocks-Mecking model provides a description of the physical phenomena of ...

Measurement of geometrically necessary dislocation (GND) density using electron backscatter diffraction (EBSD) has become rather common place in modern metallurgical ...

U Based on these large set of simulations and theoretical analysis, a new analytical relationship between material strength, dislocation density, strain rate and dislocation mobility is proposed, ...

The development of stacking faults and twins acting as kinematical barriers for dislocation motion was found to be influenced by stacking fault energy and accumulated ...

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In the exposition on the correlation tensors presented in Section Dislocation density and correlation tensors, emphasis is given on the consequences of evaluating ...

Martensitic steels exhibit a high level of work hardening at the beginning of plastic deformation despite having a high yield strength. However, the relationship between ...

During HPT processing, deformation with or without dynamic recovery/ recrystallization produces a microstructure with a high dislocation ...

ES r E [1] where is the total dislocation density, and E is the energy per unit length of dislocation line. Presupposing that the dis-locations are arranged in low-energy ...

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