

Fleck, N. A.; Hutchinson, J. W.

A phenomenological theory for strain gradient effects in plasticity. (English) Zbl 0791.73029
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Summary: A strain gradient theory of plasticity is introduced, based on the notion of statistically stored and geometrically necessary dislocations. The strain gradient theory fits within the general framework of couple stress theory and involves a single material length scale l . Minimum principles are developed for both deformation and flow theory versions of the theory which in the limit of vanishing l , reduce to their conventional counterparts: J_2 deformation and J_2 flow theory. The strain gradient theory is used to calculate the size effect associated with macroscopic strengthening due to a dilute concentration of bonded rigid particles; similarly, predictions are given for the effect of void size upon the macroscopic softening due to a dilute concentration of voids. Constitutive potentials are derived for this purpose.

MSC:

74C99 Plastic materials, materials of stress-rate and internal-variable type

Cited in **2** Reviews
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Keywords:

minimum principles; constitutive potentials; dislocations; single material length scale; J_2 flow theory; macroscopic strengthening; macroscopic softening

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