ON THE VELOCITY OF TWIN BOUNDARY

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ABSTRACT

One of the most essential features of twins is their ability to move in response to external forces, which results in growth of one of the differently oriented lattices and carries a macroscopic deformation of the material. Twin boundary motion is especially essential in shape memory alloys [1],[2], where the twins appear between different variants of martensite. The reversible reorientation of martensite via twins motion is the key mechanism of pseudoplastic straining of shape memory alloys, and the speed of this process can be decisive for the overall mechanical performance of the alloy.

Twin boundary velocity is a macroscopic characteristic of the twinning process. The velocity is measurable, but experimental results range from near-zero up to sound velocity of a material. The diversity of experimental data related to the motion of twin boundaries cannot be explained within the context of classical continuum description. The extension of the continuum description of twin boundary motion by internal variables allows for the theoretical distinction between twin slow and fast dynamics. Internal variables serve as order parameters indicating the difference in twin variants. This makes it possible to use them to identify twin boundaries. Equations of motion are coupled to evolution equations of internal variables.

The simplest possible scenario (uniaxial motion with only two twin variants) was chosen to explain the experimentally observed discrepancies in twin boundary velocities. A diffusional slow motion of twin boundaries is reproduced in the case of a single internal variable [3], and the gradient of the internal variable serves as an order parameter. In contrast, the dual internal variable approach [4] leads to a hyperbolic evolution equation for the evolution of the primary internal variable and provides fast dynamics of a twin boundary.

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