

A Numerical Approach to Martensitic Phase Transformations

Thomas Antretter⁽¹⁾, Franz Dieter Fischer⁽¹⁾, Georges Cailletaud⁽²⁾

(1) *Institute of Mechanics, Montanuniversität Leoben, Leoben, Austria*

(2) *Centre des Matériaux, École des Mines, Evry, France*

Martensitic phase transformations triggered either thermally or mechanically entail a series of peculiar effects on the macro-scale. A thermodynamic criterion, deciding upon the formation of a new martensite variant as a function of the stress state, the temperature and the martensite fraction already present, can be interpreted as transformation surface bounded by planes, which can be adapted for use as a material subroutine in a finite element program. In combination with flow-plasticity such a concept enables to explain the overall mechanical consequences of transformation induced plasticity also in the case of non-proportional thermo-mechanical loading histories. Furthermore, the computer algorithm allows to keep track of each particular variant which provides a physical reasoning for the orientation effect known e.g. in shape memory materials. The numerical predictions are in agreement with experimental observations in the case of a maraging steel.

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