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A review of constitutive models and modeling techniques for shape memory alloys

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Abstract

Constitutive models for shape memory alloys have seen significant development in the last decades. They have evolved from uniaxial, mostly empirical, relations to full-fledged mathematical descriptions accounting for many of the effects observed in these materials with an ever-higher degree of detail. The models available today are constructed using various approaches ranging from micromechanics with or without scale transition, to statistical physics and particle dynamics, to methods of classical plasticity, to energy approaches coupled with thermodynamic and conservation principles. They have finally matured to the extent where they can be utilized in reasonably accurate numerical analysis of potentially complex shape memory alloy devices subjected to non-trivial thermomechanical loading. This paper aims at providing an up-to-date review of key constitutive models for shape memory alloys, with an attempt to track their evolution from their inception to their most recent versions. The models are categorized in terms of the approach they use in describing the behavior of shape memory alloys.

Keywords: shape memory alloys; phenomenological models; micromechanical models; molecular dynamics; statistical physics.

Contents

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