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Nucleation Phenomena in Shape Memory Technology

Shape memory effects like the one way effect (1WE) and pseudoelasticity (PE) rely on the martensitic transformation, where a high temperature phase austenite transforms into a low temperature phase martensite on cooling, and the reverse transformation takes place on heating. When a first order phase transformation occurs, nucleation is the first step. It typically defines how much undercooling/overheating under/above an equilibrium temperature is required, or how long it takes until the new phase appears. Nucleation is usually stochastic and is sensitive to impurities and to microstructural details. It is usually a stochastic random process. The contribution briefly recalls the theories of homogeneous and heterogeneous nucleation. It then discusses how nucleation events can affect martensitic transformations and which type of nucleation phenomena are important for the functional properties of shape memory alloys. Special emphasis is placed on the role of microstructure.