

# Computational modelling of austenite-martensite-bainite phase transitions including carbon repartitioning

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## Abstract

Microstructure evolution in steel components during their processing has major influence on material and final product properties. This makes the simulation and control of microstructure evolution of key importance for related predictive design. The main focus of this contribution is the modelling and advanced (finite element) simulation of quenching (of components) during which transitions from austenite to martensite and bainite occur. Particularly, the high-carbon bearing steels 100Cr6 and 100CrMnSi6-4 shall be considered. Emphasis is placed on the carbon-enrichment of the austenite phase during the formation of carbide-free bainite, as changes in carbon content influence the martensite and bainite start temperature. The novel model discussed is based on the Koistinen-Marburger and Johnson-Mehl-Avrami-Kolmogorov models, whereby the carbon contents of the remaining austenite and its impact on the transformation kinetics are both taken into account. The specific model proposed is further detailed in [1], together with the related Abaqus source code. [1] T. Furlan, M. Schewe, P. Scherm, P. Retzl, E. Kozeschnik, A. Menzel. Modelling and finite element simulation of martensite and bainite phase transformations during quenching under consideration of carbon repartitioning. *Mech. Mat.*, 204:105275, 2025.

**Keywords:**

Phase transformations Carbon repartitioning High-carbon steel Quenching