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Analytical and numerical approaches to modelling of severe plastic deformation

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Abstract

Severe plastic deformation (SPD) has established itself as a potent means of producing bulk ultrafine grained and nanostructured materials. It has given rise to burgeoning research that has become an integral part of the present day materials science. This research has received a broad coverage in literature, and several recent publications (including reviews in *Progress in Materials Science*) provide a very good introduction to the history, the current status, and the potential applications of SPD technologies. There is one aspect of SPD-related research, though, which despite its enormous importance has not been covered by any substantive review, *viz.* the modelling and simulation work. Due to the complexity of SPD processing and the specificity of material behaviour at the extremely large strains involved, analytical and computational studies have been indispensable for process design, parameter optimisation, and the prediction of the microstructures and properties of the ultrafine grained materials produced. The pertinent literature is vast and often difficult to navigate. The present article addresses this aspect of SPD and provides a commented exposé of a modelling and numerical simulation toolkit that has been, or can potentially be, applied in the context of severe plastic deformation.

Keywords: severe plastic deformation; modelling; dislocation kinetics; finite-element methods

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