The Effect of Interpolation Functions in Numerical Simulation of Interphase in Dual-Phase Steels

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During manufacture of dual-phase steels, accumulation of GNDs on edge of ferrite phase causes a difference in material properties which is not normally included in micromechanical simulations. These GNDs can be accounted for by introducing a layer, called *interphase*, in the ferrite phase in which material properties of elements change as a function of distance to the phases. The interphase can be modeled by consecutive application of binary erosion on the ferrite phase in a realistic representative volume element, marking one layer of elements in each step (Fig. 1) [1]. Afterwards, the distance between each element and the nearest martensite phase (d) will be calculated, using which material properties of the element ($P_{element}$) is:

$$P_{element} = f(d) \times (P_{martensite} - P_{ferrite}) + P_{ferrite} \quad (1)$$

where $f(d)$ is the function used for interpolation between the phases.

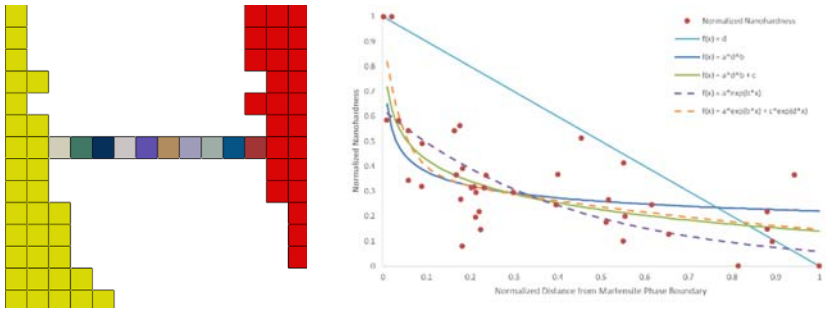

Fig. 1. left: Main phases and elements in the interphase; right: Interpolation functions used in this study.

In this study, the effect of different interpolation functions on the accuracy of stress-strain response predicted by FEA is investigated. Optimal interphase thickness is obtained using the method described in [1]. Afterwards, identical FE models were created with different interpolation functions for the interphase, which can be seen in Fig 1. Numerical constants were derived by fitting the function to microhardness data extracted from [2]. Finally, average percent error between experimental and numerical stress-strain curves was calculated for each function. All models with interphase performed better than normal 2D RVEs in predicting experiments. Different interpolation functions resulted error values ranging from 3.86% to 6.51%, with the $f(d) = ad^b + c$ being the most accurate interpolation function.

References

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