Phase-field Modeling of Widmanstätten Ferrite Formation During Austenite to Ferrite Transformation in Fe-C Alloy

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Abstract

The transformation of austenite to ferrite in steels, which is technologically important as well as of fundamental interest, still remains less well understood in some aspects. At intermediate undercooling ferrite grows with a plate-like so-called widmanstätten morphology. Some calculations, which assume that the composition at austenite/ferrite boundary is local-equilibrium and/or the morphology of ferrite is rather simple, are just fit for low dimensional simple shape and hard to be generalized. The phase-field modeling (PFM), which is proposed to simulate the complicated microstructure evolution, is anther powerful method. A phase-field model with a highly anisotropic interfacial energy is formulated for the isothermal transformation of austenite to ferrite in Fe-C system, and the coupling governing equations are solved successfully by the commercial softwareCOMSOL Multiphysics® through the mode of self-definition partial differential equation. The simulated results (Fig. 1-3) have excellent similarity with experimentally observed ones (Fig.4). Next, the effects of the anisotropy of interfacial properties and the transformation temperature on the growth kinetics of widmanstätten ferrite plates in 3D will be investigated.

Reference

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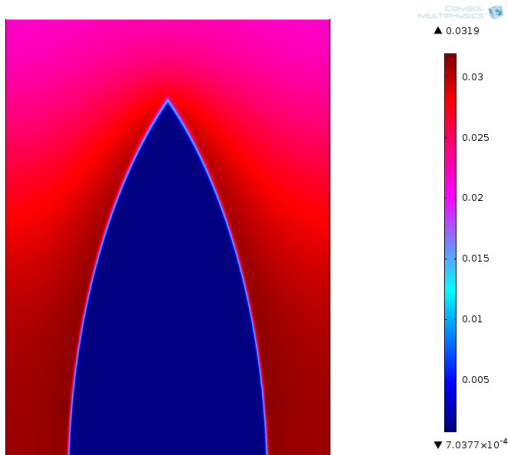
Figures used in the abstract

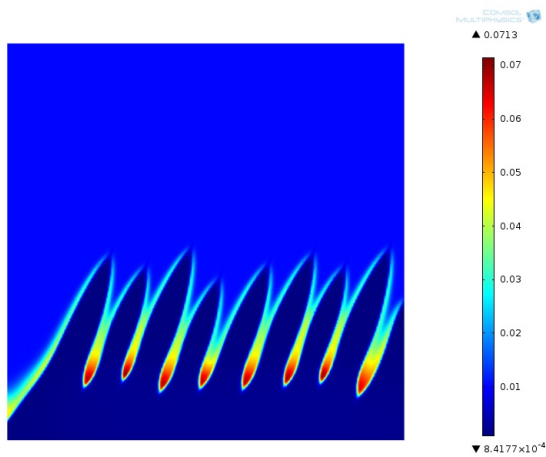**Figure 1**: Morphology of a single widmanstatten ferrite plate in 2D by PFM.

Figure 2: Colony of widmanstatten ferrite plates in 2D by PFM.

Figure 3: Morphology of a single widmanstatten ferrite plate in 3D by PFM.
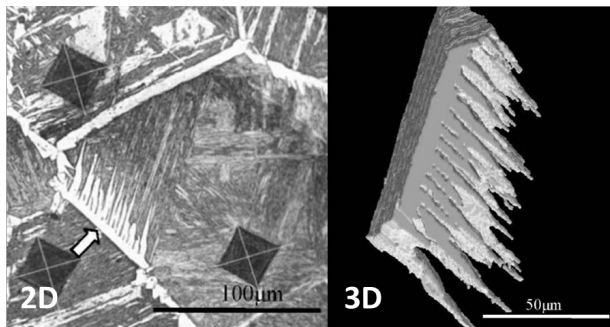

Figure 4: Morphologies of widmanstatten ferrite plates in 2D and 3D by experimental observations and reconstructions, respectively.