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Reply to comments on the solidification of gray cast iron

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Abstract

The discussion is focused on the differences between what Hillert calls "classical work in the field" and the more recent bibliography. The authors prove that the role of austenite dendrites on the solidification of eutectic and hypereutectic gray iron has been overlooked over recent years, and that the picture of the solidification mechanism was not clear.

Keywords: Iron alloys; Solidification; Gray cast iron

1. Reply

This is a reply to Professor M. Hillert's comments on our recently published paper on the solidification of gray cast iron [1]. We are grateful for Hillert's comments, who presents a careful review of earlier publications related to the subject that were not reviewed by the authors. These works, as pointed out by Hillert, are in general agreement with our experimental results and the proposed explanation of the solidification of gray cast iron.

It is very important for the reader to note that, very surprisingly, the understanding of Hillert, who stated "It seems that the deep understanding achieved by the early work in this field has now been forgotten..." is in fact true. Some of the understanding generated by "the classical work in this field", as referred to by Hillert, appears to have been ignored over the last forty years. Very well reputed text books and handbooks, frequently used as reference material in courses on both solidification and cast iron metallurgy, such as those of Flemings [2], Angus [3], Biloni and Boettinger [4], and the solidification chapter of ASM Metals Handbook [5], sketch the solidification units of flake graphite gray iron as nearly spherical shapes, called "eutectic colonies", "cells" or "grains", with no indication of the relevant presence of austenite dendrites in the case of eutectic and hypereutectic irons. A number of other authors, including Rickert and Engler [6], Fredriksson and Svensson, [7], and Roviglione and Biloni [8], also propose solidification mechanisms that neglect the existence of austenite dendrites in eutectic or hypereutectic gray irons. In addition, most computer models of the solidification of gray iron also neglect the dendritic growth of austenite.

We hope that our recent contribution to the subject, that has allowed the observation of the macrostructure of parts cast and solidified in regular conditions, obtaining a precise picture on the nature and the scale of the macrostructure, together with the reminder of Hillert about valuable early work that has been repeatedly forgotten, will call the attention of most authors and lead to a proper treatment of the subject in the future.

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