



Grain refinement of Al–Si alloys by Nb–B inoculation. Part I: Concept development and effect on binary alloys



M. Nowak, L. Bolzoni *, N. Hari Babu

BCAST (Brunel Centre for Advanced Solidification Technology), Brunel University, Uxbridge, Middlesex UB8 3PH, UK

ARTICLE INFO

Article history:

Received 15 July 2014

Accepted 21 August 2014

Available online 6 September 2014

Keywords:

Al alloys

Binary alloys

Grain refinement

Heterogeneous nucleation

Nb–B inoculation

ABSTRACT

The effect of Nb–B inoculation on Al–Si alloys for their grain refinement has been studied through the analysis of binary Al–xSi (where $x = 1–10$ wt.%) to avoid possible effects of other alloying elements. In Part I of this work the concept development of the Nb–B inoculation is discussed in detail on the basis of the theoretical and fundamental concepts employed (i.e. pro-peritectic particles formation, lattice structures and mismatch as well as analogies between the Al–Ti/Al–Nb or Ti–Si/Nb–Si binary phase diagrams). The systematic study of the addition of different level of Nb–B inoculation to pure Al permitted to determine the best addition rate. From the microstructural and thermal analysis of binary Al–xSi alloys it is found that Nb–B inoculation is highly suitable for Al–Si alloy with Si content greater than 6 wt.%. As results of the Nb–B inoculation the microstructural features of binary Al–xSi alloys (i.e. primary Al α -grains and eutectic phase) are significantly refined. Most importantly, the inoculation of Al–Si cast alloys with Nb–B is not characterised by any visible poisoning effect (i.e. formation of silicides) which is the drawback of using commercial Al–Ti–B master alloys on Al cast alloys. The effect of Nb–B inoculation on commercial Al–Si alloys (which normally include other alloying elements in their chemical composition) is assessed in Part II of this work.

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