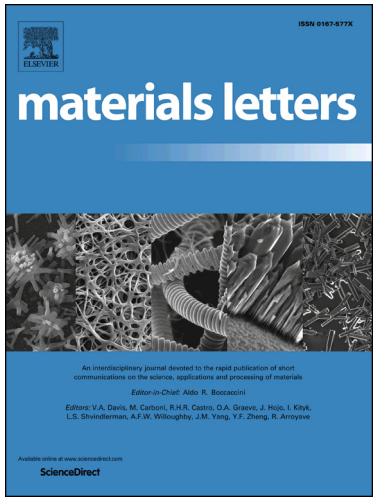

Heterogeneous nucleation in crystallization: Impact of impurities and local melt inhomogeneity

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HETEROGENEOUS NUCLEATION IN CRYSTALLIZATION: IMPACT OF IMPURITIES AND LOCAL MELT INHOMOGENEITY

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Abstract. Literature data on inoculation of metallic melts are analyzed. Ability of solid particles to facilitate heterogeneous nucleation is explained by impurity adsorption, stabilizing flat facets on inoculant particles. A new concept of initiating heterogeneous nucleation, premised on chemical inhomogeneity of melt in the vicinity of solid particles, is proposed. It is supposed that ordering in liquid phase structure in the vicinity of solid-liquid interface favors formation of crystallization nuclei.

Key words: Phase transformation, Crystallization**,** Heterogeneous nucleation, Microstructure, Cast metal.

1.INTRODUCTION

It is well known that mechanical properties of cast metal can be improved if its microstructure is fine-grained and has no columnar zone. This is usually achieved by increasing the nucleation rate and reducing the growth rate of crystallization nuclei (CN). The former can be implemented by melt inoculation – introduction of solid particles facilitating heterogeneous nucleation of CN [1,2]. The latter is a result of impurity segregation to the crystallization front. It leads to a reduction in the growth rate of the appeared crystallites, which contributes to the emergence of additional CN. In the present work, possible reasons of melt inoculation in wrought alloys are considered.

Inoculants can be added through master alloys, as, e.g., Al-5Ti-1B, used in aluminium alloys and containing TiB_2 and Al_3Ti particles [2]. Primary crystals can also act as inoculants, e.g. α-Zr grains in Mg-0.25%Zr alloy [3]. An inoculation phenomenon is supposed to take place owing to