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Morphological transformation mechanism of eutectic Si phases in Al−Si alloys by nano-AlN_p

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Abstract: In the present work, the addition of nano-AlN particles (nano-AlN_p) in Al–12Si alloy causes remarkable modification of eutectic Si phases, *i.e.*, from flaky to blocky, as well as significant improvements in the tensile strength and hardness. A diffusion couple of Al–12Si alloy and Al–8AlN alloy was designed to systematically study the modification of nano-AlN_p on Si phases. The dissolved Si atoms diffuse into the Al–8AlN side, while nano-AlN_p keep still at 750 °C, which makes the Si phases crystallize in the constricted space full of nano-AlN_p during solidification. It is found that the morphologies of Si phase within nano-AlN_p present blocky and dendritic as the local Si concentration rises up. After the comprehensive analyses of the modified Si crystals by deep etching, HRTEM and EBSD, it is inferred that nano-AlN_p agglomerations can exert restriction on the growth of Si crystals and induce multi-orientated twins to cause the morphological transformation.

Key words: Al–Si alloys; Si phase; morphological transformation; nano-AlN_p; crystal growth mechanism

1. Introduction

Al–Si series casting alloys are widely used in many fields, *e.g.* cylinder blocks and pistons, owing to its advantages on casting performance, wear resistance, low thermal expansivity and