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Formation of twin boundaries in commercial purity aluminum with addition of Ti refiner

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Abstract: This work demonstrates two phenomena both grain refinement and the proportion of twin boundaries increase from 0.3% for a randomly oriented regular FCC grain to 2.36% in equiaxial solidified Al-0.2wt.%Ti alloy. Five adjacent grains exhibiting twin relationships share the common $\langle 110 \rangle$ direction and demonstrate a fivefold symmetry axis. This special symmetry relationship gives a new light on twin grain nucleation. An abundant icosahedron in the melting is constituted of twenty regular tetrahedrons. Thus, icosahedral quasicrystal would play a role of bridge between icosahedral cluster and crystal nucleus to significantly promote nucleation.

Keywords: twin boundary; solidification; metals and alloys; quasicrystal; fivefold symmetry; EBSD

1. Introduction

Twin boundaries are generally considered as stacking faults, which would be casting defects especially in aluminum solidification [1]. Twinned dendrites are separated by a series of alternated coherent-straight and incoherent-wavy twin boundaries. Their formation would be effected by some kinetics factors [2-5]. However, twin grain nucleation is not clear. Fortunately, some recent work gives a new clue of twin

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