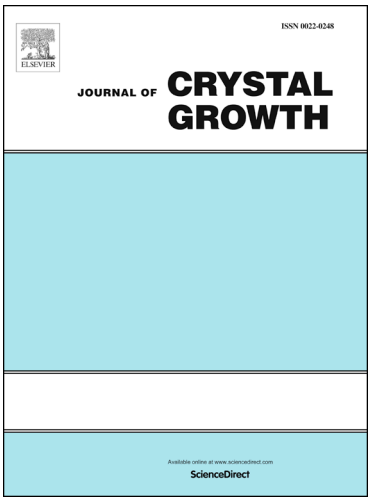

Iron single crystal growth from a lithium-rich melt

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Iron single crystal growth from a lithium-rich melt

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Abstract

α-Fe single crystals of rhombic dodecahedral habit were grown from a $Li_{84}N_{12}Fe_{\sim 3}$ melt. Crystals of several millimeter along a side form at temperatures around $T \approx 800°C$. Upon further cooling the growth competes with the formation of Fe-doped Li_3N. The b.c.c. structure and good sample quality of α-Fe single crystals were confirmed by X-ray and electron diffraction as well as magnetization measurements and chemical analysis. A nitrogen concentration of 90 ppm was detected by means of carrier gas hot extraction. Scanning electron microscopy did not reveal any sign of iron nitride precipitates.

Keywords: growth from solutions; single crystal growth; elemental solids; magnetic materials;
PACS: 81.10, 64.70, 75.50

1. Introduction

Iron is one of the most abundant materials in the earth's crust. As the main ingredient of steel it is still - and probably that won't change soon - of vital importance as a construction material. Even after many centuries of application and research elemental Fe is not as well understood as one might think. The lattice dynamics in α-Fe, for example, are significantly affected by many-body effects and have been properly modeled only quite recently [1].

The occurrence of structural transitions from δ-Fe to γ-Fe at $T = 1394°C$ and γ-Fe to α-Fe at $T = 912°C$ upon cooling does not allow for the growth of mono-domain α-Fe single crystals from the liquid. The strain-anneal method [2, 3, 4, 5] works around this problem and is the standard process for the production of commercially available bulk single crystals of α-Fe. Comparatively large single crystals can be also grown in form of whiskers [6]. Various single crystalline

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