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www.elsevier.com/locate/jcrysgro

PII: S0022-0248(16)30039-2
DOI: http://dx.doi.org/10.1016/j.jcrysgro.2016.01.039
Reference: CRYS23199

To appear in: *Journal of Crystal Growth*

Received date: 28 December 2015
Revised date: 21 January 2016
Accepted date: 22 January 2016

Cite this article as: N.M. Ferreira, A.V. Kovalevsky, M.A. Valente, J.C. Waerenborgh, J.R. Frade and F.M. Costa, Structural and redox effects in iron-doped magnesium aluminosilicates, *Journal of Crystal Growth*, http://dx.doi.org/10.1016/j.jcrysgro.2016.01.039

Structural and redox effects in iron-doped magnesium aluminosilicates

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Abstract

Magnesium aluminosilicates (MAS) represent a great importance for many electrical and catalytic applications. Recently, MAS-based glasses were considered as prospective for use as an electrolyte in steelmaking by molten oxide electrolysis process, an alternative electrometallurgical technique which offers prospects for environmental and economic advantages over traditional steelmaking.

In the present work, low-iron content MAS glasses were processed by an unconventional method: the laser floating zone (LFZ), to simulate the strongly-nonequilibrium high-temperature conditions which may arise during pyroelectrolysis process. The work focuses on the effect of pulling rate on crystallization kinetics, taking into account structural, electrical and magnetic properties of the as-grown material.

The results revealed that faster pulling rates promote formation of isolated iron cations in the glass forming network. The crystallization process is strongly affected by lower pulling rates. LFZ method shows good prospects for studying the crystallization mechanisms in silicate-based glasses with additions of redox-active cations, by providing flexibility in tuning their oxidation state and crystalline/amorphous conditions.

Keywords

A1. Glass crystallization; A1. redox properties; A2. Laser floating zone; A2. Pulling rate; B1. Magnesium aluminosilicate (MAS) glass.

Introduction