Title: Growth of trigonal gadolinium fluoride in a glass-ceramic for scintillation and optical applications

Author: D. de Faoite I. Tobin A. Ulyanov O.J. Roberts B. Shortt L. Hanlon S. McBreen K.T. Stanton

PII: S0955-2219(18)30346-7
DOI: https://doi.org/doi:10.1016/j.jeurceramsoc.2018.05.037
Reference: JECS 11915

To appear in: *Journal of the European Ceramic Society*

Received date: 3-1-2018
Revised date: 18-5-2018
Accepted date: 28-5-2018

Please cite this article as: D. de Faoite, I. Tobin, A. Ulyanov, O.J. Roberts, B. Shortt, L. Hanlon, S. McBreen, K.T. Stanton, Growth of trigonal gadolinium fluoride in a glass-ceramic for scintillation and optical applications, *<![CDATA[Journal of the European Ceramic Society]]>* (2018), https://doi.org/10.1016/j.jeurceramsoc.2018.05.037

Growth of Trigonal Gadolinium Fluoride in a Glass-Ceramic for Scintillation and Optical Applications

D. de Faoite[a], I. Tobin[b], A. Ulyanov[b], O. J. Roberts[c], B. Shortt[d], L. Hanlon[b], S. McBreen[b], K. T. Stanton[a,*]

[a]*School of Mechanical and Materials Engineering, University College Dublin, Ireland*

[b]*School of Physics, University College Dublin, Ireland*

[c]*Science and Technology Institute, Universities Space Research Association, Huntsville, Alabama, USA*

[d]*European Space Agency (ESA), European Space Research and Technology Centre, Noordwijk, Netherlands*

Abstract

This work determines the X-ray powder diffraction peak positions for trigonal GdF_3 experimentally and using simulation. An oxyfluoride matrix glass-ceramic containing the inorganic compound GdF_3 was synthesised by quench casting followed by controlled heat treatment. X-ray diffraction analysis was used to confirm the amorphous nature of the as-cast glass, and to identify the compounds crystallised in the glass-ceramic by heat treatment. A simulated powder diffraction pattern for trigonal GdF_3 was calculated and used to confirm the identity of the compound crystallised in the glass-ceramic as being trigonal GdF_3. Rietveld refinement of the structural model was performed using the measured diffraction pattern to accurately determine the unit cell parameters and asymmetric atomic coordinates. A simulated powder diffraction pattern was then calculated for trigonal GdF_3 using the refined structural parameters.

Keywords: gadolinium fluoride, glass-ceramic, scintillator, crystallisation, polymorphism

1. Introduction

Glass-ceramics incorporating scintillating compounds in the form of nano-sized crystallites are being investigated as an alternative to monocrystalline scintillators for gamma-ray spectroscopy applications [1]. Compounds investigated for such scintillators include rare earth fluoride compounds, such as LaF_3, CeF_3, GdF_3, and LuF_3, often doped with rare earth ions. Here, the trigonal polymorph of GdF_3 is investigated.

*Corresponding author
Email address: kenneth.stanton@ucd.ie (K. T. Stanton)