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Bismuth germanate (BGO) crystal - Chemical analysis of trace elements - Glow discharge mass spectrometry

锗酸铋(BGO)晶体 痕量元素化学分析 辉光放电质谱法

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Table of Contents

Foreword

This document is in accordance with the provisions of GB/T 1:1-2020 "Guidelines for Standardization Work Part 1: Structure and Drafting Rules for Standardization Documents" drafting: Please note that some contents of this document may refer to patents: The issuing agency of this document assumes no responsibility for identifying patents: This document was proposed and managed by the National Microbeam Analysis Standardization Technical Committee (SAC/TC38): This document was drafted by: Shanghai Institute of Ceramics, Chinese Academy of Sciences, Ningbo New Material Testing and Evaluation Center Co:, Ltd: The main drafters of this document: Zhuo Shangjun, Qian Rong, Zhu Yueqin, Sheng Cheng, Yang Qiu, Shi Xiaolu, Shen Shiyin:

Bismuth germanate (BGO) crystal, whose molecular formula is Bi4Ge3O12, is an inorganic scintillation material with excellent comprehensive performance: It has a wide range of applications in radiation detection fields such as energy physics, astrophysics, petroleum logging, environmental monitoring, public safety and industrial online detection: BGO crystal is a high-purity material, and there are many factors that affect material properties (such as light transmission and light output, light response uniformity, afterglow, etc:) Among them, the type and content of impurity elements are one of the key factors: For the measurement of a small amount of trace impurity elements, it is generally used to include inductance coupled plasma mass spectrometry (ICP-MS): However, if it is necessary to analyze about 70 kinds of trace impurities in BGO crystals High-resolution glow discharge mass spectrometry (GD-MS) is the preferred method for quantitative determination of the element: GD-MS quantitative analysis requires the relative sensitivity factor (RSF) of the relevant analyte to be measured with a reference substance with a similar matrix, but the

reference Test materials are often difficult to obtain: Due to the special ionization process of GD-MS, the analysis results are less affected by the matrix, so in practical application In practice a set of pre-determined RSFs is usually used for all the different matrices: However, when the measurement accuracy is required to be high, the A certified reference material, or working reference material, of the BGO matrix is necessary: Chemical Analysis of Trace Elements in Bismuth Germanate (BGO) Crystal glow discharge mass spectrometry

1 Scope

China's national method for the trace element analysis of bismuth germanate crystal by glow discharge mass spectrometry. BGO is a scintillator: a transparent crystal that emits a flash of light when a gamma ray deposits energy in it, and it is used in positron emission tomography scanners, in high energy physics calorimeters and in geological logging tools. Its virtue is stopping power - bismuth is heavy, so a BGO crystal absorbs gamma rays in a shorter length than any other common scintillator. Its performance depends on purity in a specific way: trace impurities create sites that trap the energy and release it slowly or not at all, which degrades the light output and produces the afterglow that blurs a scan. Glow discharge mass spectrometry is chosen because it analyses the solid directly, without dissolution, at the parts per billion level and for most elements simultaneously - which is what a crystal grower needs to control the process.

This document describes a method for the measurement of impurity elements in bismuth germanate (BGO) crystals using glow discharge mass spectrometry (GD-MS): This document is applicable to the determination of the content of impurity elements other than hydrogen and inert gas elements in BGO crystal materials: The measurement range 0:001μg/g~1000μg/g (mass fraction): Calibrated by a suitable standard sample, also suitable for measuring mass fractions greater than 1000 The content of impurity elements in μg/g:

2 Normative references

The contents of the following documents constitute the essential provisions of this document through normative references in the text: Among them, dated references For documents, only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to this document:

GB/T 6682 Analytical laboratory water specifications and test methods

3 Terms and Definitions

The following terms and definitions apply to this document: 3:1 ionic strength ion intensity The total amount of ion flux recorded by the instrument for the specified element: 3:

2 Needle sample pinsample A rod-shaped sample with a length of about 20 mm, a cross-sectional size of about 3 mm, and a round or square cross-section: 3:3 flake sample flatsample At least one side is flat and smooth, and the smooth side has a circular measuring surface of 20 mm ~ 40 mm: Round or square flake-shaped samples: 3:

4 Needle-shaped battery pincel Sample cell for analysis of needle-shaped samples: 3:

5 Sheet battery flatcel Sample cell for analysis of sheet samples: 3:

6 The ratio of the number of ions detected by the detector to the number of ions entering the detector: