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Nanomanufacturing – Key control characteristics – Part 6-20: Graphene-based material – Metallic impurity content: Inductively coupled plasma mass spectrometry

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CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
3.1 General terms 7
3.2 Key control characteristics measured in accordance with this document 9
4 General 9
4.1 Chemical reagents 9
4.2 Description of measurement instrument and apparatus 9
4.2.1 Measurement instrument 9
4.2.2 Sample pre-treatment apparatus 9
4.2.3 Other 9
4.3 Calibration standards 10
4.3.1 Standard stock solutions 10
4.3.2 Internal standard (IS) solutions 10
5 Sample preparation method 10
5.1 General 10
5.2 Sample pre-treatment procedure 10
6 Measurement procedure 12
6.1 Calibration of ICP-MS instrument 12
6.2 Quantitative measurement procedure 12
6.2.1 Whole element scanning 12
6.2.2 Quantitative measurement of metal impurities 12
6.2.3 Method recovery measurement 12
6.2.4 Standard recovery measurement 12
7 Data analysis 13
7.1 Content of metal impurities in test samples 13
7.2 Standard recovery 13
8 Measurement uncertainty estimation 13
9 Measurement report 14
9.1 General 14
9.2 Product or sample identification 14
9.3 Measurement conditions 14
9.4 Measurement specific information 14
9.5 Measurement results 14
Annex A (informative) Case study for FLG powder 16
A.1 Test sample 16
A.2 Sample pre-treatment 16
A.3 Instrument information 16
A.4 Standard calibration curve 16
A.4.1 Standard stock solutions 16
A.4.2 Standard calibration curve 17
A.5 Measurement procedure 17
A.6 Measurement results 17
Annex B (informative) Case study for rGO powder 19

B.1 Test sample 19
B.2 Sample pre-treatment 19
B.3 Measurement instrument 19
B.4 Standard calibration curve 19
B.5 Measurement results 21
B.6 Standard recovery 22
Annex C (informative) Comparison of different pre-treatment methods 24
C.1 Test sample 24
C.2 Comparison of different pre-treatment methods 24
C.2.1 GO test sample preparation 24
C.2.2 rGO test sample preparation 25
C.3 Comparison of different digestion conditions 25
Annex D (informative) Results comparison of ICP-MS and ICP-OES 27
D.1 Test sample 27
D.2 Measurement results comparison between ICP-MS and ICP-OES 27
Bibliography 28

Figure A.1 – Content distribution of metal impurities detected in FLG test sample 18
Figure B.1 – Standard calibration curves of several metal elements contained in rGO test sample 20
Figure B.2 – Content distribution of metal impurities detected in rGO test sample 22
Figure B.3 – Standard recovery of most species of metal impurities in rGO test sample 23
Figure C.1 – Result comparison of three pre-treatment methods for industrial GO powder 25
Figure C.2 – Result comparison of different digestion methods for industrial rGO powder 25
Figure C.3 – Content of metal impurities detected in rGO test sample using microwave-assisted digestion under different digestion conditions 26

Table 1 – Potential interferences for several typical elements in industrial graphene powder 12
Table A.1 – Content of all metal impurities detected in FLG test sample 17
Table B.1 – Content of all metal impurities detected in rGO test sample 21
Table D.1 – Measurement results comparison between ICP-MS and ICP-OES 27

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NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 6-20: Graphene-based material – Metallic impurity content: Inductively coupled plasma mass spectrometry

FOREWORD

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IEC TS 62607-6-20 has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
113/609/DTS	113/629/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts of the IEC TS 62607 series, published under the general title *Nanomanufacturing – Key control characteristics*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Graphene-based materials have wide potential applications because of their unique electrical, thermal and mechanical properties, especially in the electronics industry: batteries, integrated circuits, high-frequency electronics, displays, etc. [1], [2], [3][1]. As industry uptake on graphene-based materials increases, international standardization is critical to enable the commercialization of graphene-based materials and related products. Metal impurities within graphene-based materials have significant impact on the electrical performance in the process of industrial application. Considering the multiple production routes and producers of graphene-based materials, in order to maintain product quality and reach a consensus between the supplier and the customer, there is no doubt that accurate, reliable and reproducible measurement methods for the key parameters of graphene-based materials need to be established.

Inductively coupled plasma mass spectrometry (ICP-MS) can carry out accurate detection of trace amounts of a variety of metal impurities simultaneously, obtain species and content of each metal impurity in graphene-based materials.

The purpose of this document is to enable accurate and quantitative determination of metal impurities using ICP-MS [4], through providing optimized digestion operation, preparation procedures for graphene-based materials in powder form, measurement method and data analysis. A similar document was published as ISO/TS 13278 for carbon nanotubes (CNTs) [5]; however, it is not suitable for graphene powder because of the noticeable difference between CNTs and graphene powder, especially in terms of sample preparation (including digestion technique and digestion procedure), the properties of test samples (many more species and much wider range of content of metal impurities in graphene powder), measurement procedure and so on. Therefore, this document has been developed for graphene powder; it is based on study in VAMAS Technical Working Area 41 (TWA 41).

[1] Numbers in square brackets refer to the Bibliography.

NANOMANUFACTURING – KEY CONTROL CHARACTERISTICS –

Part 6-20: Graphene-based material – Metallic impurity content: Inductively coupled plasma mass spectrometry h

1 Scope

This part of IEC TS 62607 establishes a standardized method to determine the chemical key control characteristic

– metallic impurity content

for powders of graphene-based materials by

– inductively coupled plasma mass spectrometry (ICP-MS).

The metallic impurity content is derived by the signal intensity of measured elements through MS spectrum of ICP-MS.

– The method is applicable for powder of graphene and related materials, including bilayer graphene (2LG), trilayer graphene (3LG), few-layer graphene (FLG), reduced graphene oxide (rGO) and graphene oxide (GO).
– The typical application area is in the microelectronics industry, e.g. conductive pastes, displays, etc., for manufacturers to guide material design, and for downstream users to select suitable products.

2 Normative references

There are no normative references in this document.