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GB/T 47076-2026

Surface chemical analysis - X-ray photoelectron spectroscopy - Measurement of binding energy for conductive carbon-based materials

表面化学分析 X射线光电子能谱 导电碳基材料结合能的测量

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part

1.Structure and Drafting Rules of Standardization Documents". Drafting. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed and is under the jurisdiction of the National Technical Committee on Standardization of Surface Chemical Analysis (SAC/TC608). This document was drafted by: National Center for Nanoscience and Technology, Institute of Chemistry, Chinese Academy of Sciences, Tsinghua University, Beijing Normal University, and Sinopec. Oil and Chemical Research Institute Co., Ltd., Beijing University of Science and Technology, China National Institute of Metrology, China National Institute of Standardization. The main drafters of this document are. Xu Peng, Liu Renxiao, Zhao Zhijuan, Yao Wenqing, Wu Zhenglong, Qiu Limei, Li Zhanping, Liu Fen, Ge Guanglu, and Guo Yanjun. Zhu Xiaoyang, Ren Lingling, Zhang Xiaoyu, Yang Yunguo, Xin Mudi, Jia Hefeng.

Conductive carbon-based materials possess excellent electrical, mechanical, and thermal properties, and have become an indispensable key material in the fields of new energy and new materials. Materials. The unique electrical properties of conductive carbon-based materials originate from their sp2 hybrid structure, which can be analyzed using X-ray photoelectron spectroscopy (XPS). The ability to accurately measure and determine the elemental composition and chemical state of materials is crucial for the development and application of conductive carbon-based materials. A basic analytical tool. Currently used

XPS sample preparation and binding energy measurement methods have significant uncertainties when applied to conductive carbon-based materials. Insulating sample preparation... The testing process resulted in an over-neutralized sample surface, and the resulting binding energy data typically needs to be corrected for external contaminant carbon before it can be used. Compared to sp2 hybridized carbon in conductive carbon-based materials, the sp3 hybridized contaminating carbon adsorbed on object surfaces exhibits not only different C1s spectral shapes but also... The binding energies differ significantly, and their inherent binding energies are unstable, varying with material properties and the environment. Therefore, sp3 hybridized exogenous pollutant carbon is used. Correcting XPS peaks in conductive carbon-based materials can easily lead to confusion in understanding and use [2]~[5]. Accurate measurement of the binding energy of carbon-based conductive materials is crucial. Problems that urgently need to be solved[6][7]. This paper utilizes the good electrical conductivity of carbon-based materials [8][9], and proposes a method that does not require charge correction and directly... A method for measuring the binding energy of conductive carbon-based materials. Before XPS testing of the mounted sample, the surface charge accumulation and measurement specifications are assessed. The testing process allows for the direct measurement of the binding energy of relevant elements in this type of material. This document provides methods for the accurate measurement of the binding energy of conductive carbon-based materials. Establishing standardized procedures facilitates the correct analysis and use of XPS data, and promotes the standardization of XPS measurement methods within the carbon-based materials industry. Standardization and effective comparison of measurement results are provided. Appendix B reports the results of interlaboratory verification experiments. Surface chemical analysis X-ray photoelectron spectroscopy Measurement of binding energy of conductive carbon-based materials

1 Scope

GB/T 47076-2026 is the Chinese national standard covering getting the binding energy right on graphene, graphite and carbon blacks - XPS energies shift with charging and with the reference chosen, and the carbon 1s peak is itself the usual reference, which makes a conductive carbon a circular and much-argued case. First edition, under the Chinese Academy of Sciences. It was issued on 28 January 2026 and has been in force since 1 August 2026, as a first edition. The document is under the responsibility of the Chinese Academy of Sciences. This page is published from the official record of the 2026 edition; the clause text of a standard this recent is not yet in circulation, and the figures, limits and tables it contains are those of the document itself, delivered in full with the English translation.

This document describes a method for measuring the binding energy of conductive carbon-based materials using X-ray photoelectron spectroscopy (XPS). This document applies to the measurement of the binding energy of conductive carbon-based materials

such as carbon nanotubes, graphene, and graphite.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included. For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies. This document.

GB/T 19500 General Rules for X-ray Photoelectron Spectroscopy Analysis of Surface Chemical Analysis

GB/T 22461.1 Terminology for Surface Chemical Analysis Part

3 Terms and Definitions

The terms and definitions defined in GB/T 19500 and GB/T 22461.1, as well as the following terms and definitions, apply to this document.

3.1 conductive carbon-based materials A carbon-based material with good stability and electrical conductivity.

Note. Conductive carbon-based materials are classified into zero-dimensional, one-dimensional, two-dimensional, and three-dimensional carbon-based materials. Zero-dimensional carbon-based materials include carbon quantum dots and fullerenes; one-dimensional carbon-based materials... Materials include carbon fibers, carbon nanotubes, and carbon nanowires; two-dimensional carbon-based materials include graphene; three-dimensional carbon-based materials include graphite, activated carbon, conductive carbon black, and carbon. Aerogels and their composites, etc.

4.Symbols and Abbreviations The following symbols and abbreviations apply to this document. hnu. Incident photon energy phiS. Sample work function phiSP. Spectrometer work function ESK. Photoelectron kinetic energy emitted from the sample surface EFB. Photoelectron binding energy emitted from the sample surface ESPK. Photoelectron kinetic energy detected by the spectrometer