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Fundamental structures of one dimensional nanomaterials - High resolution electron microscopy characterization

一维纳米材料的基本结构 高分辨透射电子显微镜检测方法

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Foreword

The guidance of technical documents by the National Standardization Technical Committee of nanotechnology nanotechnology materials sub-technical committee. The guidance of technical documents by the National Standardization Technical Committee Nano Nanomaterials Technical Committee. The guidance of technical documents Drafting Unit. Institute of Physics, Chinese Academy of Sciences electron microscope laboratory. The main drafters of this technical guidance. Li Jianqi. Basic structure of one - dimensional nanomaterials High resolution transmission Electron microscopy test method

1 Scope

This guiding technical document specifies the principle, the terms and definitions, the instruments and equipment, the preparation of samples, the measuring procedure, the expression of results and the test report for the examination of one-dimensional or quasi-one-dimensional nanomaterials among nanomaterials by high-resolution transmission electron microscopy. This guiding technical document applies to the measurement of the basic structure of one-dimensional or quasi-one-dimensional nanomaterials - the morphology, the state of arrangement, the distribution of size, the state of crystallization and the relation of growth orientation - together with the elemental composition and the atomic arrangement at cross sections and interfaces.

This guidance document prescribes the use of high resolution transmission electron microscopy to detect one-dimensional or quasi-one-dimensional nanomaterials in nanomaterials Terms, definitions and definitions, instruments and equipment, sample preparation, measurement procedures, presentation of results and test reports. This guidance document is suitable for measuring the basic structure of one-dimensional or quasi-one-dimensional nanomaterials (topography, alignment, Cloth, crystallization, growth orientation), elemental composition, cross section and interface atomic arrangement.

2 Normative references

The following documents contain provisions which, through reference in this Guidance Document, become the provisions of this Guidance Note document. All dated Reference documents, all subsequent amendments (not including errata content), or revisions do not apply to this guidance document, however, drums Recipients of the agreement based on this guidance document are encouraged to study whether the latest versions of these documents are applicable. All undated references The latest version of this document applies to this guidance document.

GB/T 19619 nanomaterials terminology

3 Terms and definitions

GB/T 19619 established and the following terms and definitions apply to the guidance of

technical documents.

3.1 The shape of nanomaterials is filamentous and usually includes nanofibers, nanotubes, nanowires and nanoribbons.

3.2 In the two-dimensional direction for the nano-scale, the third dimension of the macro-scale direction of the new nano-materials.

3.3 Transmission electron microscopy with atomic resolution up to the atomic level. In the low magnification pattern can be a variety of materials for direct morphology observation, Granularity analysis. The crystal structure of the material can be studied by electron diffraction analysis and high-resolution electron microscopy. With the spectrometer can be right A variety of elements for qualitative, quantitative and semi-quantitative analysis of the composition of micro-elements, is a combination of image and energy spectrum characterization means.

4 Principle

Electrons are volatile and will interact with matter when diffraction occurs. Three-dimensional periodic distribution of matter can be crystal lattice and Its reciprocal lattice description. The single cell basis vectors , , and the reciprocal lattice of the lattice lattice , , satisfy the following reciprocity relations, · = · = · = 1, · = · = · = · = · = · = 0. When the diffraction vector is equal to reciprocal Strong diffraction of electric wave happens when vector. Transmission electron microscopy made on the basis of the above principles is a powerful tool for studying the microstructure of materials One of the [1]. It consists of electronic optical system, vacuum system, power supply control system and additional instrument system composed of four parts. The most important electronics Optical system, divided into lighting system, imaging system and camera system in three parts. Part of the lighting by the electron gun and two condenser and other components. Imaging Part of the objective, intermediate mirror and projection lens and other components. Fig. 1a), Fig. 1b) schematically shows the imaging using a three-stage magnification electron microscope Optical path in mode and diffraction mode. Its imaging principle and the optical microscope imaging principle (ignoring the movement of electrons in the magnetic field by