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Nanotechnologies - Electron microscopy imaging of noble metal nanoparticles - High angle annular dark field imaging method

纳米技术 贵金属纳米颗粒电子显微镜成像 高角环形暗场法

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Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009. This standard proposed by the Chinese Academy of Sciences. This standard by the National Institute of Technology Standardization Technical Committee (SAC/TC279) centralized. This standard is mainly drafted by the National Nano Science Center, Beijing Powder Technology Association. The main drafters of this standard. Qi Xiao Ying, Chang often autumn, Zhu Xiaoyang, He Meng, plateau.

Because of their quantum effect, small size effect and surface effect, noble metal nanoparticles exhibit many unique physical and chemical properties. Catalytic, energy, optics, electronics and biology and other fields have broad application prospects. Due to the size of the noble metal nanoparticles, agglomeration, particles Grain uniformity and its properties are closely related, so the characterization of the topography is particularly important. In practical applications, precious metal nanoparticles The particles typically form a composite with their support, with common scanning electron microscopy, transmission electron diffraction contrast imaging, and high resolution phase contrast Techniques like technology can not effectively distinguish between precious metal particles and their supports. High-angle toroidal dark-field imaging is a use of the ring in scan-transmission mode The shape detector collects high-angle scattering electron imaging and the contrast of the resulting image is approximately proportional to the square of the atomic number of the element, thus Can effectively distinguish the noble metal particles in the composite system, and has atomic resolution, which is very suitable for the noble metal nanoparticles Imaging. The method also applies to the imaging of micron-sized particles. At present, the high-angle annular dark field imaging method is a mature method of characterization. In the system equipped with a scanning coil and a high-angle annular dark field detector Transmission electron microscopy or scanning electron microscopy can be achieved. Because of its image contrast and atomic number are closely related to the noble metal nano More and more people are beginning to use this technique to analyze nanoparticle samples in the characterization of rice particles. The validity of the levy has also been gradually recognized and has played an important role in scientific research and production. Nanotechnology Precious metal nanoparticle electron microscopy imaging High-angle ring dark field method

1 Scope

China's national standard for imaging noble metal nanoparticles by high angle annular dark field scanning transmission electron microscopy. The technique is the right one for this material for a reason worth stating. In conventional transmission electron microscopy the contrast comes from diffraction and phase, which depends on how each particle happens to be oriented and makes quantitative interpretation awkward. High angle annular dark field instead collects electrons scattered through large angles, which is nearly pure Rutherford scattering, and its intensity goes roughly as the square of atomic number. The image is therefore a map of how much heavy material lies in the beam path - which for gold, platinum, palladium or silver particles on a light support such as carbon or alumina gives an image of brilliant particles on a dark background, with intensity that can be read as size and mass. That is what makes it the method of choice for catalyst characterisation, where the whole question is how the metal is dispersed on the support.

This standard specifies the use of electron microscopy high angle annular dark field imaging of precious metal nanoparticles imaging method. This standard applies to a single precious metal nanoparticles and composite materials in the imaging of noble metal nanoparticles.

2 Normative references

The following documents for the application of this document is essential. For dated references, only the dated version applies to this article Pieces. For undated references, the latest edition (including all amendments) applies to this document.

GB/T 19619 nanomaterials terminology

3 Terms and definitions

GB/T 19619 defined and the following terms and definitions apply to this document.

3.1 Nanoparticle The external dimensions of the three dimensions are all on the nanoscale. Note If the difference between the longest axis and the shortest axis of the nanostructures is significant (greater than 3), the nanorods and nanosheets are used to represent the nanoparticles. [GB/T 32269-2015, Definition 4.1]

3.2 Noblemetal Gold, silver and platinum group metals collectively. [GB/T 17684-2008, Definition 2.1]

3.3 Scanning transmission electron microscopy scanningtransmissionelectronmicroscopy; STEM An analytic technique by which detectors simultaneously receive transmitted or scattered electrons from a converging electron beam to produce an image.

Note. Generally used in field emission transmission electron microscopy, and some field

emission scanning electron microscope is also equipped with scanning transmission mode, there are special scanning transmission Sub-microscope.

3.4 High angle annular dark field imaging highangleannulardarkfieldimaging; HAADF Scanning transmission electron microscopy using high angle scattering electron imaging. 4 high-angle annular dark field imaging principle

4.1 In a transmission electron microscope or a scanning electron microscope, a convergent electron beam is used to scan the sample and the coil is controlled by a dot-by-dot sweep While scanning each point, a circular detector with a certain inner ring aperture placed below the sample synchronously receives power scattered by high angles Sub, as shown in Figure 1, and the signal is converted to current intensity displayed on the screen or computer screen. This method does not use the center The transmission of electrons, so the dark field image is observed.