XRD, TEM Techniques for Nano Crystalline Thin Films

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Abstract: ***There are number of techniques to analyze and characterize any material in nano particle. Thin films and bulk form. In the present work to determine the purity, stoichiometric composition, structural determination microscopy, to get particle size and shape, optical studies, thermal studies of nano particles and thin films. There are number of techniques such as EDAX (Energy Dispersive Analysis of X-ray) XRD (X-Ray diffretometer), TEM (Transmission Electron Microscopy), Ruman Spectroscopy, TGA (Thermogravimetric Analysis), UV-VIS-NIR Spectrometer.***

Keywords: Optical, chemical properties, cancer research, condenser lens, Brugg's law.

1. Introduction

Nano particles have large number of surface atoms compared to the bulk. So the properties of the surface atoms are very important. The number of techniques can be used to analyze and characterize of any nano particles. For nano particles, the size and surface effect both are important. By controlling these, it is possible to design materials of required optical, magnetic, elastic and chemical properties.

1.1 Basic Principle of TEM

In TEM methods, a beam of electrons incident on the specimen. So, diffraction takes place, and all the diffracted beam of electrons are falls on the phosphor screen, in which shadow of the specimen appear TEM forms a major analysis method in a range of scientific fields in both physical and biological science [1], [2].

1.2 Application of TEM

In cancer research, material science, pollution and semiconductor research.

2. Construction

In the column of the telescope, electrons are produced from the electron gun, and they travel in the vacuum. Vacuum should be necessary because if they travel through air, then electrons collide with the charged particles of the air, so the beam of the electrons are disturbed. These negatively charged particles do not affected by the glass, so we use glass as a electromagnets. By increasing the strength of the glass, behave as electromagnet, focusing of the electrons are increasing. Finally diffracted beams incident on the specimen. Depending on the density of specimen, some electron beams are scattered and disappeared from the beam. Finally, electron beams are incident on the fluorescent screen, image is formed on the fluorescent according to their density. This image can be studied with the help of CCD (Camera).

3. Experimental Set up

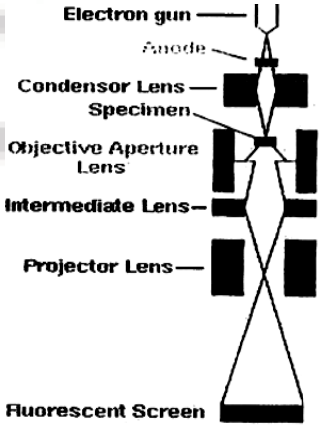

Figure 1: Electrons are generated+

In Figure 1, electrons are generated from the electron gun, having 100 KeV energy. Main part of the TEM, (1) condenser lens (2) objective lens (3) projector. The condenser lenses are responsible for primary beam function, while the objective lens focus the beam down on to the sample. Again a fine beam of the image can be made with the help of the projector lens. A projector lens expand the image and incident on the fluorescent lens and it is connected with The CCD (Camera) [3].

3.1 Basic principle of X-ray Diffraction (XRD)

In XRD method, from cathode ray tube, X-rays are produced and moncorhomatic X0rays are produced with the help of the filter. Now constructive interference is produced between the monochromatic X0ray and crystalline sample. This interference pattern (diffracted ray) obey the Bragg's law, $2^{nd}\ \sin\theta = n\lambda$. These diffracted X-rays are then detected, processed and counted. Detector is moving up to 2 θ angle as shown in fig, and X-rays are detected.

3.2 Application of XRD

To determine both the structure and size of sample, it can provide information on unit cell dimension, and rapid analytical technique [4].

3.3 Experimental Setup

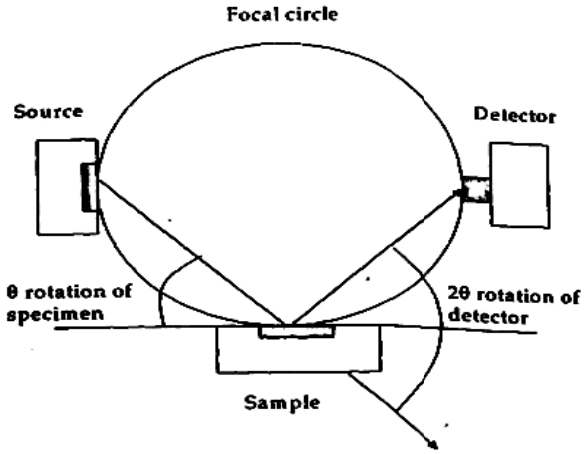

Figure 2

There are three parts of XRD (I) X-ray source (II) The sample under investigation (III) detector. A current is passing through a filament, which is kept in the evacuated tube, electrons are generated. With 15-60 kilovolts high voltage, electrons are generated and hit the target. Target is made of copper. An x-ray with definite wavelength is produced, this definite wavelength indicate the characteristic of the X-ray. Collimating X-ray incident on the crystalline fine powder sample, so X-rays are diffracted. We obtain satisfaction of Bragg's equation $2d \sin\theta = n\lambda$ by continuously moving sample and detector. This detector detect X-ray signal and converting it into count rate. The intensity of diffracted X-rays is continuously recorded as the sample and detector rotate through their respective angles [5] [6].

4. Conclusion

From TEM image, we can say that particle size range between 9 nm to 10 nm. In XRD, nano particles and nano crystalline FCC's (Face Centre Cube) are detected. The particle size can be detected up to 3 nm to 5 nm. Lattice parameter also be calculated.

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