Journal of Advances in Developmental Research (IJAIDR)

E-ISSN: 0976-4844 ● Website: www.ijaidr.com ● Email: editor@ijaidr.com

Study the growth of layers, their composition and defects in semiconductors by using Transmission Electron Microscopy (TEM) UV-visible (UV-V is.) spectrophotometer, Vibrating sample magnetometer (VSM)

Dr. P. Laveena Manjulatha

Asst prof of Physics

Department of Physics, MALD Government Degree College, Jogulamba Gadwal-509125, India.

Abstract:

This paper deals with Transmission Electron Microscopy (TEM) Importance. The TEM is a very important technique for material science. A high energy beam of electrons is shone through a very thin material, and the interactions between the atoms and the electrons can be used to examine the crystal structure and features in the structure like grain boundaries and dislocations. And the chemical analysis can also be analyzed. To study the growth of layers, their composition and defects in semiconductors by using TEM analysis. The material quality, size, shape, and density of quantum wells, dots and wires are exactly analyzed when take the image at high resolution.

Key words: Transmission Electron Microscopy (TEM) UV-visible (UV-V is.) spectrophotometer, Vibrating sample magnetometer (VSM), EDAX detector.

Introduction

TEM uses high energy electrons that are up to 300 kV accelerating voltage. These are accelerated to nearly the speed of light. The electron beam behaves like a wave front with wavelength about a million times shorter than light waves. When an electron beam passes through a thin-section specimen of a material, electrons are scattered. A sophisticated system of electromagnetic lenses focuses the scattered electrons into an image or a diffraction pattern, or a nano-analytical spectrum, depending on the mode of operation.

Each of these modes offers a various insight about the sample. The imaging mode provides a highly magnified view of the micro- and nanostructure and ultimately, in the high resolution imaging mode a direct map of atomic arrangements can be obtained (high resolution TEM = HRTEM). The diffraction mode (electron diffraction) displays accurate information about the local crystal structure. The nano analytical modes (X-ray and electron spectrometry)

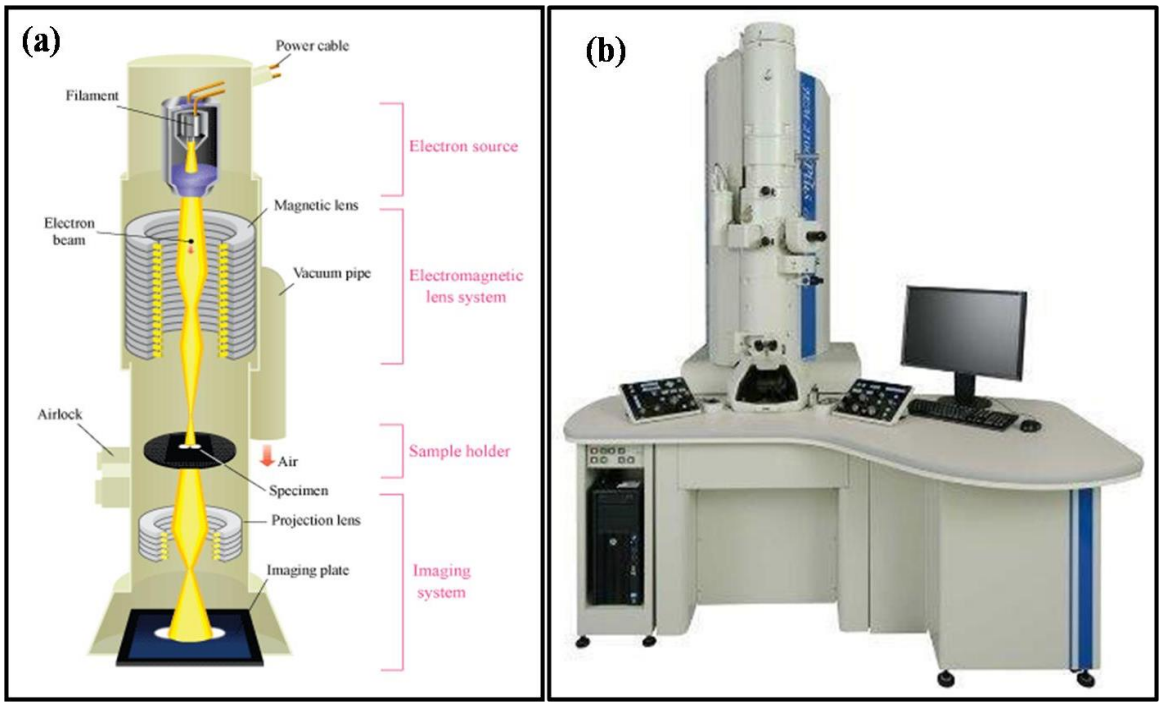
Tell to researchers which types of elements are present in the small volume of sample. These modes of operation give precious information for engineers and research scientists in search of stronger materials,

faster microchips, or smaller nanocrystals

Analysis

For analysis of the materials those were pre-dispersing in methanol using ultrasonic bath and followed by evaporating a drop of resultant suspension onto the copper grid. It is possible to calculate particle dimensions, average particle size, size distribution and aspect ratio with provided set of high-resolution digital TIFF images for each sample. There are a number of software packages with options for image processing and measuring of preferably to make particle measurements. The analysis of individual un-agglomerated spherical particles is straight forward. However, when nanoparticles are agglomerated or have mixed morphology, correct size statistics can be more difficult to obtain. Chemical composition and abundance of elements in the sample can be detected by EDAX detector.

For particles that are bound together, the necking between particles is examined to determine if the particles were potentially well distributed in solution or other hand the particles are sintered together. If we is tributed, the diameter of each particle is used as them If sintered or mixed shapes, diameter of the particle is measured at a fixed angle for everyone of particles in the picture. Since, the orientation of the particles is usually random; the resultant analyses are representative of the sum and standard deviation of the material. An alternative method of analyzing sintered or non-spherical particles is to use image analysis software to find out the cross-sectional area of the particles and convert the area to an equivalent sphere-shaped diameter. Fig. 2.7 (a and b) shows schematic outline of a TEM, and JEOL JEM 2100 HRTEM image.



UV-visible (UV-V is.)spectrophotometer Importance

UV-Vis. spectroscopy is one of the most important analytical technique could be employed to estimate the amount of both inorganic and organic analysts quantitatively. The absorbance shift of UV-Vis. spectra also gives the indirect structural information. By using this we can estimate band gap of the given material by Tauc plot method.

Principle

The amount of absorption at fixed wavelength is explained by Beer-Lamberts law, which states that the absorbance of analyte is directly proportional to the concentration and path length of solution. UV-Vis. spectroscopy is following the Beer-Lambert law. It is formulated as: $A = \alpha Cb$ Eq.(2.3)

where, α is represented as the molar abosorptivity, C is the concentration and b is the path of length, respectively. The optical band gap energy (E_g) values for prepared samples could be calculated by using the below expression and the Tauc method from this region of the UV-vis. spectra [16].

$(\alpha h\nu)^2 = B(h\nu - Eg)$ Eq. (2.4)

here, α is the absorption coefficient, hν is the photon energy and B is the material-dependent constant. The optical band gap values for their on oxidepowders were calculated by$(\alpha h\nu)^2$vs. $h\nu$ and extrapolating a straight line part of the plot to the photon energy axis.

measurement for the size measurements Analysis

Initially, baseline correction was done by blank solvent in which the sample to be dissolved. Then, for analysis of the materials those were pre-dispersing in solvent using ultrasonic bath and this liquid dispersed material is taking into quartz cuvette.

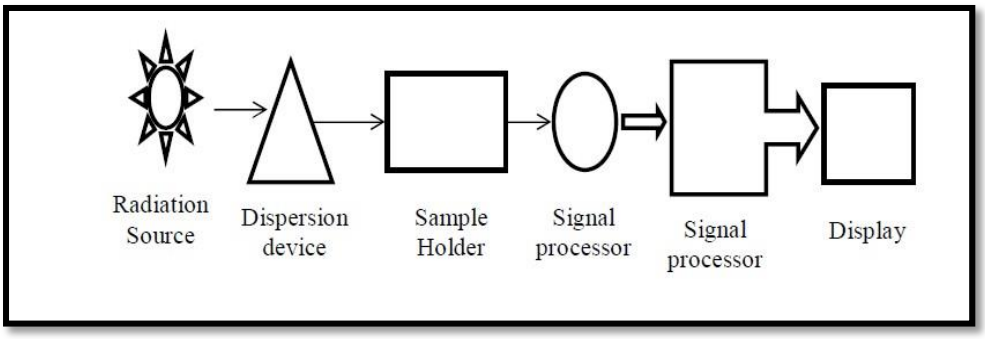


Fig .2.11 Schematic representation of UV-V is.spectrophotometer.

Molecules with π and nonbonding electrons, present in the sample which absorb the UV- Visible radiation and undergo electronic transitions. Here, the wave length of light absorbed is directly proportional to the band gap between ground and excited states. The spectrometers used for UV, Vis. and IR regions have certain common features and the functions of the components are similar.

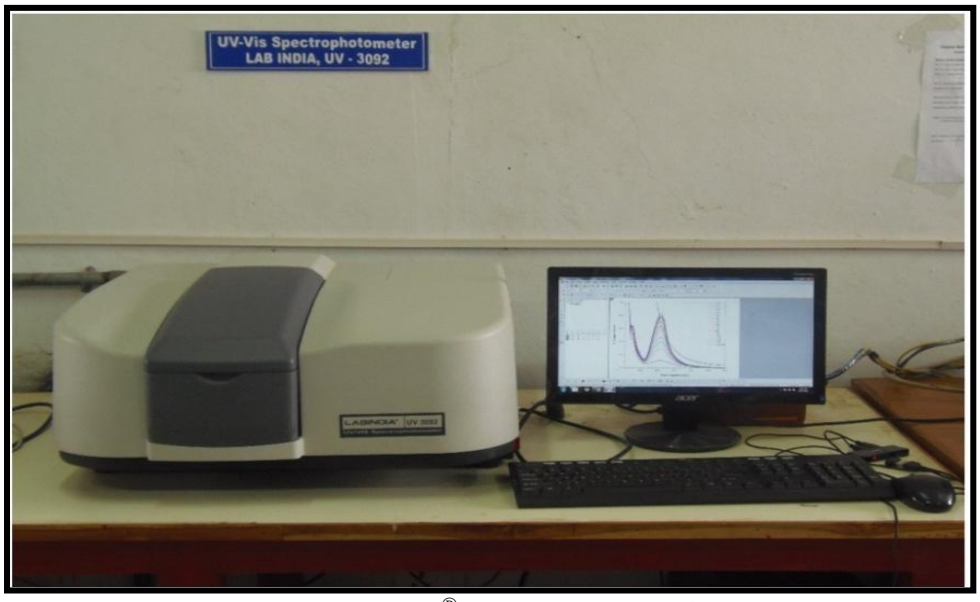


Fig.2.12 LABINDIA®,UV3092 spectrophotometer.

The schematic representation or the basic components of UV-V is.spectrometer is shown in Fig.2.11. The arrangement of the basic components depends on the nature of measurement. For measuring the absorbance, the basic components of spectrometer is linearly arranged, so that the transmitted radiation passes on the detector [6]. UV-Vis. spectra and absorbance of liquid dispersed samples were recorded on LAB INDIA-3092 model UV-Vis. spectrometer, shown in Fig. 2.12.

Vibrating sample magnetometer (VSM)

A popular method, has been determine the magnetic properties of wide variety of magnetic materials by a VSM technique. With this technique the magnetic moment of a material can be measured with a high accuracy. The measurements can be performed in a DC external field. Some of the VSM has also the facility of measuring the magnetic moment at different temperatures increasing even more the area of investigations. In our work, room temperature measurements of hysteresis loops were performed on a regular basis in order to establish the suitability of a certain production method for our objectives and to contribute to understanding of the magnetic permeability behavior at high frequencies. The magnetization of the material

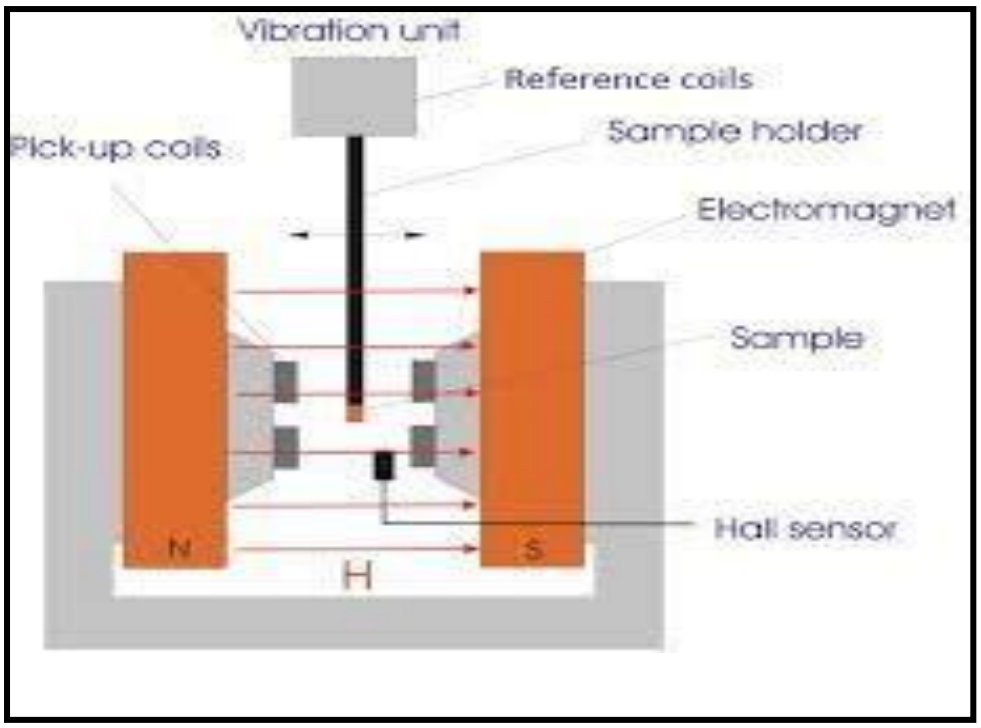


Fig.2.13 S chematic diagram of a VSM.

creates a magnetic stray field which is frequency modulated by vibrating the sample. As the material is situated between a pair of pick-up coils, an AC voltage with the same frequency and proportional to the sample magnetization is induced in the coils. Schematic diagram of vibrating sample magnetometer was shown in Fig.2.13.

A lock-in amplifier is used to provide the frequency of vibrations and to detect the signal.Special attention was given to obtain constant amplitude of the oscillationsover the time interval specific to our measurements. The system is calibrated with a magnetic material with a known saturation magnetization, e.g. Ni. A Hall probe was used in order to determine the values of the applied field. Using the computer interface, the magnetic field and the signal proportional to the magnetic moment can be simultaneously recorded (hysteresis loops). The sensitivity of the instrument was sufficient to measure hysteresis loops of Fe samples with a thickness of only 10 nm.

Fig.2.14 Princeton Micro Mag, AGM 2900 vibrating sample magnetometer(VSM) instrument.

It is important to mention that the absolute values of the saturation magnetization (M_S) can be determined only if the density and the amount of magnetic material are precisely known (M_S = magnetic moment/sample volume). For very thin films this can be a difficult task. Fig. 2.14 represents the Princeton Micro Mag, AGM 2900 vibrating sample magnetometer (VSM) instrument [5].

Acknowledgement: Author is thankful to the Nanosciencelab HOU Hyderabad.

Conflict of Interest: Author has no conflict of interest

REFERENCES:

1. W.Wu, Z.Wu, T.Yu, C.Jiang, WS.Kim, *Sci.Technol. Adv.Mater.*2015,16, 023501.
2. S.Sōmiya,R.Roy,*Bull.Mater.Sci.*,2000,23,453.
3. H.Hayashi,Y.Hakuta,*Materials*,2010,3, 3794.
4. M.A.Wahab,Solid StatePhysics,*Narosapublishing housePvt.Ltd.*,2005
5. M. S. Ramachandra Rao and S. Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers,*Wiley India Pvt. Ltd.*, 2013.
6. D. A. Skoog,F. J. Holler ,S. R. Crouch, Principles of Instrumental Analysis, *Belmont, CA: Thomson Brooks*, 2007.