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Determination of Optical and Structure Properties for Semiconductor Marital Manufacture by Nickel

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Abstract

In this work, nickel oxide Nano-material samples were prepared with different concentration (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1) m Molar by doping with magnesium oxide with respect to the formula ($Ni_xMg_{1-x}O_2$). Optical Properties of nickel doping by different concentration of magnesium measured by using the UV- Spectroscopy min 1240, The Nano crystal size of all samples were measured by XRD technique, and studying the effect of different concentrations on the particle size and crystal properties of all samples. The study effaced of different concentration on the optical parameters before and after irradiation by gamma rays, for all samples the absorbance increases upon increasing the concentration, while the transmission decreases. The value of energy band gap (E_g) was decreased from (3.757) eV to (3.503) eV. The density increasing by rat 0.009 mg. Cm^3/molar. Particle Size decreasing by rated 3.18 nm / molar, and d-spacing were decrease molar rated 1.9x 10^{-10}m / molar.

Introduction

Solids are materials whose atoms are bonded strongly enough to form a rigid structure, the elements and their compounds which aggregate into the solid cuble, classified as amorphous, poly crystalline, single crystalline materials depend on arrangement of atoms in the materials. When the atoms in the materials are arranged in regular manner with a three – dimensional periodicity that extends throughout a given volume the solid, the material is considered to be as crystal. In poly crystalline materials the periodic arrange of atom is interrupted randomly along two-dimensional sections that can interest dividing a given volume of solid into a number of smaller single crystalline regions. If, however, there is no periodicity in the arrangement of atom the material is classified as amorphous. Although semi conducting properties are observed in all three classes of solids, we restrict our attention to semi conducting materials in single crystalline for doing this. The erotically, when we consider that the spacing between nearest neighbor atoms in a solid is typically several angstroms (10^{-8} cm) we find this enormous number of atoms were arranged randomly in the material it would be very difficult to construed a useful physically theory of semiconductor behavior [1,2,3].

In single crystals however, the theoretical problems are reduced to manageable size and we find that many of the important properties of solids are actually determined by the periodicity of the atoms. Practically the use of single crystal is greatly simplifying a number of the processing steps the high device fields that are characteristic of modern integrated circuit technology. Also charge carriers in device operations, most useful semiconductor devices are fabricated with single crystalline material

Semiconductor materials at have basically the same structure as insulators filled valence band separated from any empty conduction band by a band gap containing no allowed energy states. Band gap is the distance between the valence bands essentially, the band gap represents the minimum energy that required to excite an electron up to a state in the conduction band where it can participate in condition [4]. The difference ties into size of band gap ^{E}g, which is smaller in semiconductors than in insulators. The relatively small band gaps of semiconductors allow for excitations of electrons from the lower valence band to the upper conduction band by reasonable amount of thermal or optical energy at the room temperature semiconductors with Eg 1.0ev will have a significant number of electrons excited thermally a cross the energy gap into the conduction band, where as an insulator with Eg ~ 10.0 eV will have an eligible number of such excitations. Thus, an important difference between semiconductors and insulators is that the number of electrons available for conduction can be increased greatly in semiconductors by thermal or optical energy. The distinction between insulators and semiconductors is one of degree rather than kind insulator has larger band gaps perhaps 3 eV on more, while semiconductors have band gaps ranging from 2.5 eV down to 0.1 eV.

In metals the bands either overlap or one only partially filled thus electrons or empty energy states are intermixed within the bands so that electrons can move freely under the influence of an electric field [5, 6, 7].

Materials and Methods

Sample Preparation

10 samples of Nickel oxide doped by magnesium oxide with respect to the formula ($Ni_xMg_{1-x}O$) were synthesized by chemical precipitation method were dissolved in100 mL double distilled water (de-ionized water) separately under stirring at room temperature**,** drop wise addition of Magnesium with rated (0.1, 0.3 ,0.5 ,0.7 and 0.9) m Molar solution was stirred using magnetic stirrer at 3000 rpm for 2 hours at room temperature. Then the annealed sample was grinded to get the powdered nanoparticles, the crystal structure of all samples characterized at 80^{o} temperature.

The optical properties of all samples characterized at room temperature using min 1240 UV-Spectroscopy. From optical spectra of synthesized calculate all optical properties (Absorption, transition, Reflection, Absorption Coefficient, Extinction coefficient, Optical Energy Band Gap, Refractive Index, Real Dielectric Constant and Imaginary Dielectric Constant).

Characterization Techniques

The Materials Characterization Lab has a wide variety of characterization techniques in the areas of X-ray diffractometer, and min 1240 UV- Spectroscopy techniques which help to increase the different degrees of understanding why different materials show different properties and behaviors.

To investigate the optical properties of Nickel doped by magnesium with rated (0.1, 0.3, 0.5, 0.7 and 0.9) m Molar nanoparticles, some precise techniques have been used in our study. The following characterizations have been potentially performed for the analytical of the synthesized samples.

Ultraviolet -visible spectroscopy (UV-VIS)

Ultraviolet and Visible Spectroscopy is absorption spectroscopy uses electromagnetic radiations between 190 nm to 800 nm and is divided into the ultraviolet (UV, 190-400 nm) and visible (VIS, 400-800 nm) regions. Since the absorption of ultraviolet or visible radiation by a molecule leads transition among electronic energy levels of the molecule, it is also often called as electronic spectroscopy. When radiation interacts with matter, a number of

processes can occur, including reflection, scattering, absorbance, Fluorescence phosphorescence (absorption and emission), and photochemical reaction (absorbance and bond breaking).

In general, when measuring UV-visible spectra, we want only absorbance to occur. Because light is a form of energy, absorption of light by matter causes the energy content of the molecules (or atoms) to increase. The total potential energy of a molecule generally is represented as the sum of its electronic, vibrational, and rotational energies.

Figure (1): UV mini 1240 spectrometer shimadzu

X-ray Diffractometers (XRD)

X-ray diffractometers consist of three basic elements: an X-ray tube, a sample holder, and an X-ray detector. X-rays are generated in a cathode ray tube by heating a filament to produce electrons, accelerating the electrons toward a target by applying a voltage, and bombarding the target material with electrons. When electrons have sufficient energy to dislodge inner shell electrons of the target material, characteristic X-ray spectra are produced. These spectra consist of several components, the most common being Kα and Kβ. Kα consists, in part, of Kα1 and Kα2. Kα1 has a slightly shorter wavelength and twice the intensity as Kα2.

The specific wavelengths are characteristic of the target material, filtering by foils or crystal monochromators, is required to produce monochromatic X-rays needed. For diffraction. Kα1and Kα2 are sufficiently close in wavelength such that a weighted average of the two is used. Copper is the most common target material for single-crystal diffraction, with CuKα radiation = 1.5418Å. These X-rays are collimated and directed onto the sample. As the sample and detector are rotated, the intensity of the reflected X-rays is recorded. When the geometry of the incident X-rays impinging the sample satisfies the Bragg Equation, constructive interference occurs and a peak in intensity occurs. A detector records and processes this X-ray signal and converts the signal to a count rate which is then output to a device such as a printer or computer monitor. The geometry of an X-ray diffractometer is such that the sample rotates in the path of the collimated X-ray beam at an angle θ while the X-ray detector is mounted on an arm to collect the diffracted X-rays and rotates at an angle of 2θ. The instrument used to maintain the angle and rotate the sample is termed a goniometer.

For typical powder patterns, data is collected at 2θ from ~5° to 70°, angles that are preset in the X-ray scan.

Figure (2) X-Ray diffractometer: XRD (wavelength 1.54 A°)

Results

This study used of XRD for analysis and characterization of Ni $_x$Mg $_{1-x}$O$_2$ sample

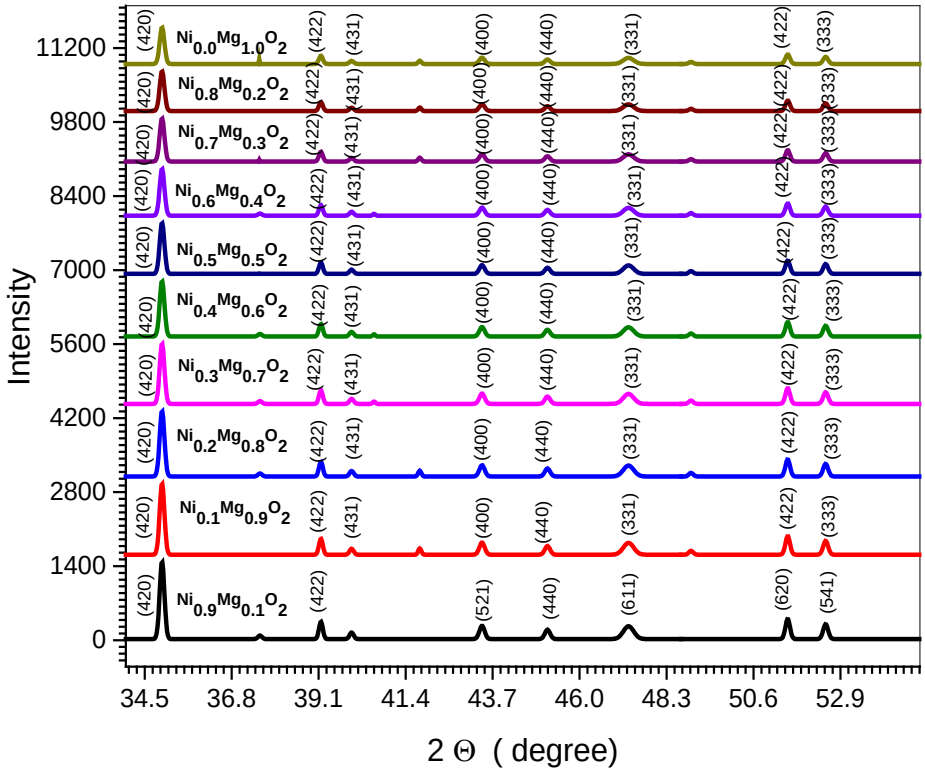

Fig (3): XRD spectrum of Nickel doped by Magnesium Ni$_x$ Mg $_{1-x}$ O $_2$ before exposure by Gamma ray (35gray)44

Table (4.1) XRD crystal structures parameters of Nickel doped by Magnesium Ni_x Mg $_{1-x}$ O $_2$ before exposure by Gamma ray (35gray)

XRD Data		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Space Group		I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)	I a -3 d (230)
Crystal System		cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic
Cell Parameters 10^{-10} m	a	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
	b	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
	c	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
Density (g.cm^{-3})		3.683	3.681	3.679	3.675	3.673	3.671	3.669	3.667	3.664	3.662
Volume $(10^{-10})^3$		594.0	594.1	594.3	594.6	594.9	595.1	595.3	595.5	595.7	595.9
d (10^{-10} m)		1.762	1.765	1.767	1.769	1.771	1.772	1.773	1.775	1.778	1.781
Cell Angular	alpha	90	90	90	90	90	90	90	90	90	90
	beta	90	90	90	90	90	90	90	90	90	90
	gamma	90	90	90	90	90	90	90	90	90	90

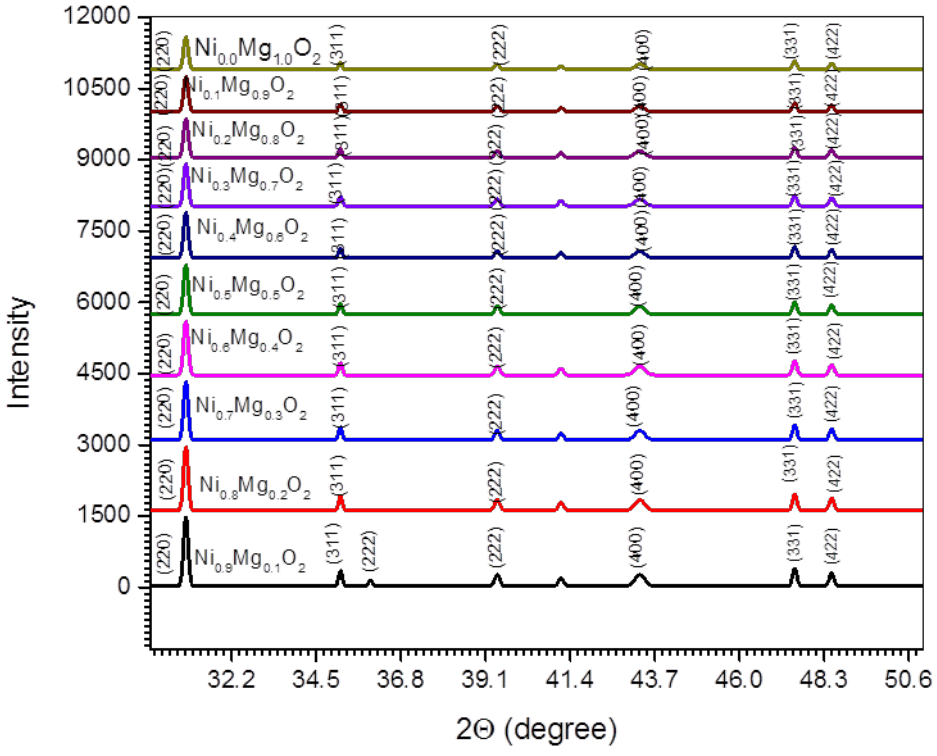

Fig (4): XRD spectrum of Nickel doped by Magnesium Ni_x Mg $_{1-x}$ O $_2$ after exposure by Gamma ray (35gray)

Table (2) XRD crystal structures parameters of Nickel doped by Magnesium Ni_x Mg_{1-x}

XRD Data		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Space Group		F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)	F d -3 m (227)
Crystal System		cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic	cubic
Cell Parameters 10^{-10} m	a	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299
	b	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299
	c	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299	8.299
Density ($g.cm^{-3}$)		4.683	4.681	4.679	4.675	4.673	4.671	4.669	4.667	4.664	4.653
Volume $(10^{-10})^3$		570.0	570.1	570.3	570.6	570.9	571.1	571.3	571.5	571.6	571.7
d (10^{-10} m)		2.258	2.260	2.261	2.263	2.265	2.267	2.269	2.270	2.271	2.272
Cell Angular	alpha	90	90	90	90	90	90	90	90	90	90
	beta	90	90	90	90	90	90	90	90	90	90
	gamma	90	90	90	90	90	90	90	90	90	90

O_2 after exposure by Gamma ray (35gray)

Conclusion & Discussion

The crystal structure of all samples characterized at room temperature using X-ray diffractometer (operated at 40 kV and current of 30 mA) and samples were scanned between 10^O and 80^O. The representative XRD charts of all ten samples different concentration Nix Mg_{1-x} O_2 as show in fig (3) before exposure. Miller indices provided in the figure for all peaks determine transformation of ten samples different concentration Nix Mg_{1-x} O_2 Molar crystallites with cubic crystal structure. Fig (3) describes the relation between the concentration and density of samples, and table (1) shows the XRD parameters value of ten samples different concentrations at various crystalline orientations. It is show that before exposure the space group is [I a -3 d (230)] and crystal shape are cubic for all samples and the cell parameters values (a, b, c) is equal to11.47, the density between (3.683-3.662) ($g.cm^{-3}$), the density of sample increase by concentration increase the of nickel in the samples increasing. The values of volume range is (594.0-595.9) $(10^{-10}$ m$)^3$ and the values of d- space are in range (1.762-1.781) (10^{-10}m), the cell angular is 90 degree for all samples after exposure fig (4) shows that the behavior of the different samples as peaks diagram and table (2) give some parameters of all samples after exposure by Gamma ray (35gray) , the space group values are F d -3 m (227) and also the shape of crystals are cubic , the cell parameters values (a ,b ,c) are 8.299 and density range (4.683-4.653) ($g.cm^{-3}$), the volume of all samples after to exposure by Gamma ray (35gray) in range (570.0-571.9) $(10^{-10}$ m$)^3$, the cell angular is equal 90 degree for all samples. On the other hand, it's noticed that the rated of concentration increases concentration decreasing the crystals size, the relation between the rated of and d- spacing of concentration samples ten in different nanoparticles samples, and noticed that the rated of decreasing the d- spacing of samples different concentration.

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