Journal of Multidisciplinary Engineering Science Studies (JMESS)
ISSN: 2458-925X
Vol. 2 Issue 7, July - 2016

Synthesis And Characterization Of Nanoparticles Mgo Films On Silicon Substrates For Solar Cells Applications

Ban Rasheed Ali
Department of physics, Collage of science, AL-MustainsiryahUniversity ,Baghdad, Iraq.
Corresponding author: ahmed_naji_abd@yahoo.com

***Abstract*—The properties of Magnesium Oxide nanoparticles MgO NPs studied and analyzed after preparing it by using Nd-YAG Laser ablation for Mg ablated in methanol solution . XRD showed that the deposited this film has a cubic structure and there is no trace of the other material .XRD patterns shows three basic peaks due to three diffraction angles .The deposited thin film is covered with uniformly distribution as explained in the3D AFM image and granularity accumulation distributionThe optical properties showed that the optical band gap of the ablated MgO NPs in methanol solution was (2.7 eV) . The I-V charcterstics of the Al/MgO/Si/Al hetrojunction showed that the conversion efficiency was (1%) and F.F. (33.6 %).**

Keywords—MgO, laser ablation , structure properties, AFM, optical properties, solar cell.

1. Introduction

In the last years nanomaterials have many attentions due to its success in improving the efficiency of many applications [1]across multiple domains such as biology ,physics ,chemistry , optical components polymer science, mechanical engineering [2,3].].This research discuss the preparation , properties, and one of the most important applications (solar cell) of magnesium oxid nanoparticles .MgO NPs has a lot of applications in various areas [4].MgO NPs are odorless and non-toxic. They possess high hardness , high purity high melting point (2852 C^o) and it is appear in white powder form.MgO has a low dielectric constant and low refractive index which make it useful for superconductor applications and optical confinement in ferroelectric /MgO /semiconductor waveguide structure [5]MgO NPs can be prepared using the hydroxide precipitation process , which is followed by thermal decomposition of the hydroxide [6]In this work MgO NPs were prepared by laser ablation in methanol and the properties of it were studied after deposited on a glass substrate using drop casting method and MgO NPs characterized by X-Ray diffraction and atomic force microscope .Pulsed laser ablation (PLA) in liquid was first reported by [Patil and et al 1987] who applied pulse laser to ablate a pure iron target in water [7], this method is known as liquid phase pulsed laser ablation (PLAL) where a metal target is immersed in liquid solution and laser pulses is focused through the liquid on to the target surface [8] .

.The pulsed laser ablation in liquid (PLAL) has become the most popular approach for producing metallic colloids [9]. .The pulsed laser ablation in liquid (PLAL) has become the most popular approach for producing metallic colloids [9].

2. Experimental

Magnesium powder with purity of 99% and M.W. (24.31 g／M) from Redial-deHaen com. Compress as abilte to prepare target with diameter (1.5cm) then immersed the pelt in methanol for (24 hours) at room temperature to clear it.

Laser ablation in liquids (LAL) were used by applying (1400 pulses) of Nd-YAG laser (λ= 1064nm) for preparing freshly MgO NPs solution from the target that immersed in (15ml) methanol until the color of the solution has been changed due to MgO NPs production via quantum size effects MgO NPs were deposited on a glass substrate by drop casting method only. Using X-Ray diffraction (XRD-6000 shimadzu X-ray diffraction) analysis which are relive information about the molecular structure of the sample. The patterns obtained gives the investigation of MgO NPs as illustrated in figure (2). The optical transmittance were measured by using (UV-Visible spectrophotometer from VARIAN) and the optical properties were studied using Microsoft axial program which are illustrated in figures(3,4,5,6). The silicon sample was used as a substrate for MgO/Si hetrojunction . To provide front and back omiccontacts , purity aluminum were evaporating and a light of (40 mW/cm2) power were used for vaporization .

3. Results and discussion

The XRD analysis of MgO thin film on a glass substrate shows an agreement with the standard card (PDF card –MgO-00-030-0794) from search .The XRD patterns have three essential peaks at three diffraction angles (38.32º,44.47º) due to miller indices (222),(400) respectively as explained in figure (2).

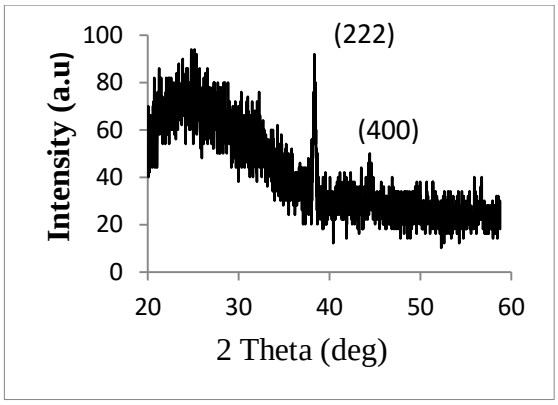

Fig.2 XRD pattern for MgO thin film.

Figure (3) shows the 3-D AFMimage and Granularity accumulation distribution of MgONPs .the deposited thin film is covered with uniformly distribution of spherical or semispherical MgO NPs . After using computerized calculation of the MgO NPs sample we find that RAV was (1.24 nm) ,root mean square (R.M.S equal 1.44nm) and the average diameter of the particles was (65.14nm) .in UV-regain ,the transmission is sharply decreases because of the wide of absorbed particle size.

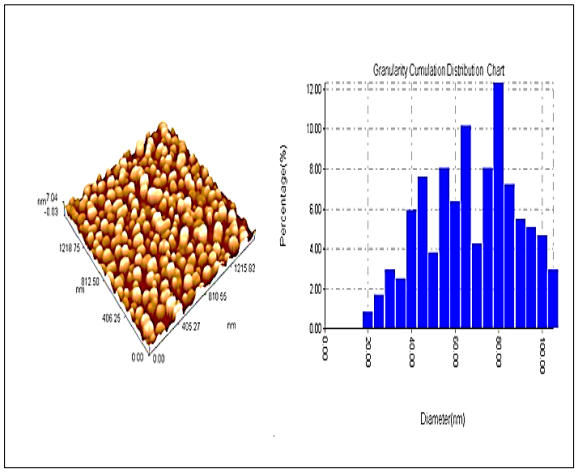

Fig.3 AFM images of MgO thin films

From figure (4) between $(hv)^2$ in the Y-axis and photon energy in X-axis to find the exact energy band gap and it was (2.7eV). However, in the quantum confinement theories the band gap reduces to lower values compared with the bulk material due to smaller particle size [10] and due to the quantity of NPs in the suspension.

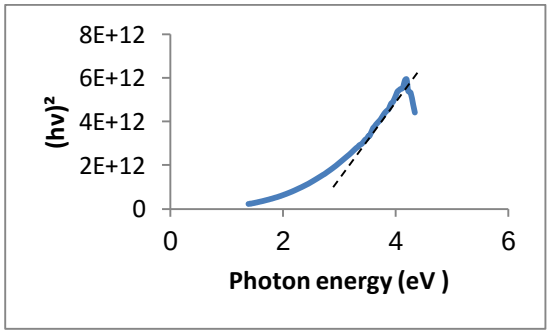

Fig .4 *$(\alpha hv)^2$ versus optical energy gap*

Figure (5) shows the transmittance of MgO NPs which prepared by laser ablation using fixed laser energy (500mJ) and repetition rate (1Hz) .this figure shows increase of transmittance with increasing wavelength (in the range 300-900 nm) until reaching the saturation region.

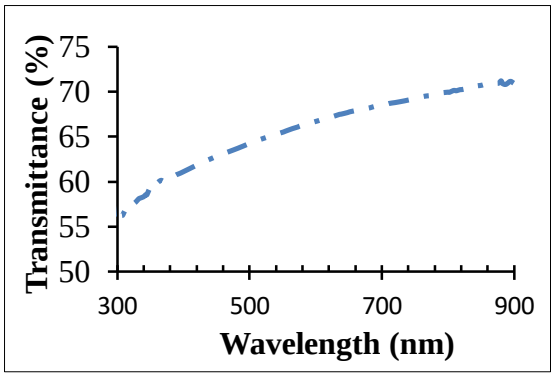

Fig .5 Transmissionspectra for MgO Thin film.

Figure (6) shows a decrease in reflectance with increasing wavelength while figure (7) shows also a decreasing in refractive index with increasing wavelength.

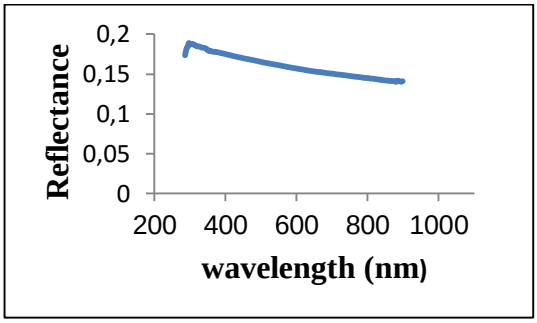

Fig.6 Reflectance Spectra for MgOThin film

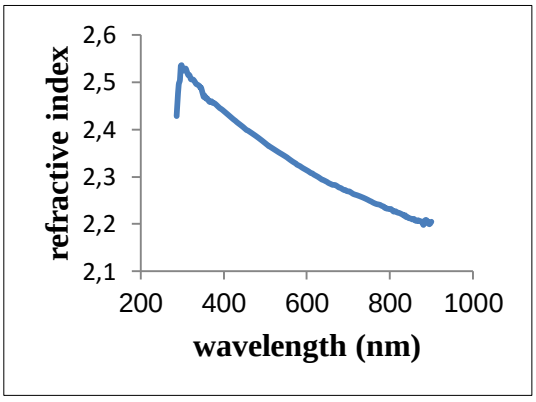

Fig.7refractive Spectra for MgO Thin film

Figure (8) shows the I-V Characteristics under forward and reverse bias of the (Al/MgO /Si /Al) Hetrojunction .

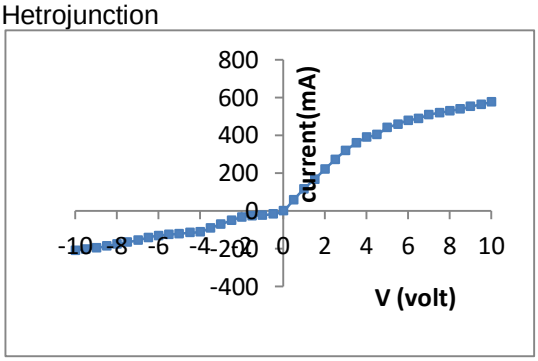

fig.8 I-V of MgOthin films

From figure (9) which shows I-V characteristics under illumination and to compute the conversion efficiency (ŋ) and the fill factor (F.F.) Where ImVm is the usage power Pi is the incident power , A is the cell area , Isc is the short circuit current , Voc 0pen circuit voltage ,Isc*Voc is the real power . It was found that the conversion efficiency (1%) and F.F. (33.6%) .It is obvious clear from show figure (9) that the current value under illumination is higher than that in dark under the same voltageand that'sbecause the generation of electron-hole as a result of the light absorption [12].

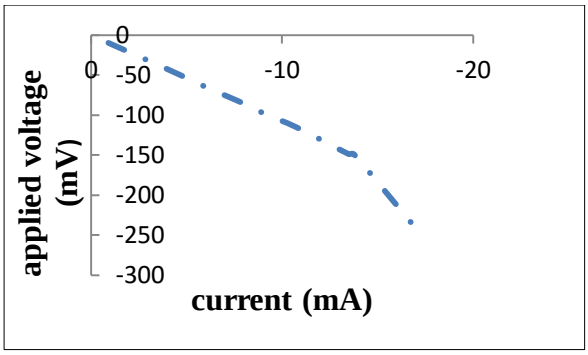

Fig .9 Photocurrnt under illumination of MgOThinfilms

4. Conclusions

MgO thin film shows a good optical transparency and low refractive index .MgO/Si hetrojunction was successfully fabricated using thermal deposition of silicon deposited on MgO thin film , the deposited thin film was covered with uniformly distribution . The sandwich structure p-Mgo/n-Si could be used as a solar cell [11] . To increase power efficiency , structures of the solar cell should be optimized.

References.

1.A.N.Abd , N.F.Habubi &R.N. Ismail, Preparation of colloidal cadmium selenid nanoparticles by pulsed laser ablation in methanol and toluene ,Journal of materials science Materials in Electronics DOI 10.1007/ s10854-014-(2002)

2.J.F.Scott,C.A.Paz de Araujo,Science ,vol . 246,p.1400, (1989).

3. D.L. Polla ,C.Ye, P.J. Schiller ,T.Tamagawa, W.P. Robbins , D. Glumac , C.C. Hseuh

4. Shukla, S.K.,Parashar, G.K. ,Mishra, A.P., Misra P. , Yadav,B.C., Nano-like magnesium Oxide films and its significance in optical fiber humidity- Snsor Actuator B. Chem. ,98,5- 11,(2004)

5. C. P. Wang , K. B. Do et al., Appl. Phys. Lett. , vol 71 , p2955 , (1997).

6. Armendia, et al , Synthesis and characterization of various MgO and related system , J. Mater. Chem., 6, 1943-1949,(1996). 7. Patil P P. Phase D M,Kulkarni S A, Ghaisas S V , Kulkarni S K , Kanetkar S M , Ogale S B , Bhide V G , Phys. Rev. Lett., 58,238 , (1987).

8. Ogale S B , Thin solid Films , 163, 215, (1988).

9. R.G. Kadhim , M. F. Noori ,A.K. Ali , Preparation of Gold nanoparticles pulsed laser by

ablation in NaOH solution , J. of Babylon University / Pure and Applied Science / No.1/ vol.(22), (2012).

10. R.A.Abdullah , M.A. Razooqi and A.N. Al-Ajili , characterization of the Energy Band Diagram of Fabricated SnO_2 / CdS/CdTe Solar Cell ,J. World Academy of Science , Engineering and Technology , 79:118-122,(2013).

11. A.N.Abd , R. S. Ali , A.A. Hussein , Fabrication and characterization of Nickel Hetrerojunction Oxid Nanoparticles / Silicon, J. of Multibidisciplinary Engineering Science studies (JMESS) , vol.2,Issue4, April,(2016).

12. T.Oku, R.Motoyoshi, K.Fujimoto, T.Akiyama, B.Jeyadevan, J.Cuya, Structures and photovoltaic properties of copper oxides/fullerene solar cells, J. Phys. Chem. Solids 72 1206-1211 (2011).