Experimental and Theoretical NANOTECHNOLOGY
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The Influence of RF power, pressure and substrate temperature on the energy gap to vanadium oxide at tallness wave stir 290 nm of RF sputtered

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In this work, the (V2O5) films were deposited on glass substrates which produce by using "radio frequency (RF)"power supply and Argon gas technique and the nano-thin film deposition is obtained from a V2O5 target (5 mm in diameter and 5mm thickness) by the gradual variation of sputtering power 150 Watt and variation pressure (0.03, 0.05 and 0.007) Torr. The Energy Gap were investigated by, UV spectroscopy at "radio frequency" (RF) power ranging from 150 Watt and and substrate temperature (359, 373,473 and 573 K) and gas pressure (0.03, 0.05 and 0.007 Torr). The Energy Gap of the Vanadium Oxide thin film deposited by RF magnetron sputtering were analysis by UV-Visible spectroscopy shows that the average transmittance of all films in the range 40-65 %. When the thickness has been increased the transhumance was decreased from 65-40%. The values of energy gap were decreased from (3.02-2.7 eV) with the increase of thickness the films in relation to an increase in power. The energy gap decreased (2.8 - 2.7) eV with an increase in the substrate temperature respectively and the pressure.

Keywords: V_2O_5; Energy gap; Thin films; RF Sputtering.

1. INTRODUCTION

The development of low dimensional metal oxides is imperative due to their promising device applications such as photo detectors. Researchers have focused on the synthesis of these materials and fabricate of metal oxides Nano devices. For several years silicon-based devices have been further developed and to date have represented the core of the entire semiconductor industry [1]. The(V2O5) favoring materials for electronic and photovoltaic implementations [2]. Vanadium oxide (V2O5) is an n-type semiconductor that is both more stable and has a high oxidation case [3]. Vanadium oxide is a material that shows a phase transition of semiconductor to metal when is heated around of a critical temperature 257 ± 5 °C. Now a days the study of vanadium oxides thin film, has received a great deals because of their interesting electrical, optoelectronic properties, optical switches and the potential use of these devices as thermal sensing, and energy saving devices with in the development of smart windows They have been processed in thin film configuration to develop electrical and optical devices; especially the vanadium pent oxide (V_2O_5), a wide band gap and n-type semiconductor material [4] . There has been tremendous recent interest in V_2O_5 in view of its material characteristics, which can be readily integrated into many scientific and technological applications. These include applications in electro chromic and photochromic devices, electronic information displays, color memory devices, micro batteries and smart windows, chemical sensing, catalysis, and optical / electrical switching, photo detectors [5]. The V_2O_5 is an effective material in the industrialization of many solid state devices, such as the sensors, optical-electrical switches [6].The (V_2O_5) is the most stable juncture among all mangle phases (V_nO_{2n+1}), exhibits interesting electrical, optical and electrochemical properties[7].V_2O_5" thin films have been prepared by various methods such as sputtering [8], vacuum evaporation[9], pulsed laser deposition [9], sol-gel [10], chemical vapor deposition[11], spray pyrolysis" [12], thermal evaporation [13]and electron beam evaporation [14]. Nanoparticle V_2O_5 thin films are used to overcome this issue by increasing the surface area and decreasing the diffusion distance [15].

2 EXPERIMENTAL

In this work, V_2O_5 films were prepared by the RF magnetron system (CRC600 CO. Manufactured in the USA).Prepared thin films on glass Substrate in different power, pressure and substrate temperatures . The chamber was evacuated under low pressure ($3x\ 10^{-5}$) Torr. The glass slides were sequentially cleaned in an ultrasonic bath with acetone and ethanol. Finally they were rinsed with distilled water and dried. . The optical properties measurements for (V_2O_5) thin films obtained by using the UV-Visible recording Spectrometer (UV-2601 PC Shimadzu software 1700, 1650), made in Japan. The thickness of the films has been calculated by using Device the FT-650 Film Thickness (FT) Probe System.. Use the V_2O_5 deposition of RF Sputtering in pure argon gas (99.9%) with pressure (0.03,0.05 and 0.007Torr). With different of RF power (75, 100, 125, and 150 watts), with various substrate temperatures were (359, 373, 473 and 573 K) respectively.

2.1 RF magnetron Sputtering System

The CRC-600 system is shown in Figure (1-2). It consists of a vacuum system including a turbo-molecular pump, direct drive oil sealed rotary vacuum pump or dry scroll rotary pump, a quartz crystal thickness monitor, a stainless steel chamber with viewport, planar magnetron sputtering source (s), (DC) and or (RF) power supply and substrate with and without rotation including temperature controller.

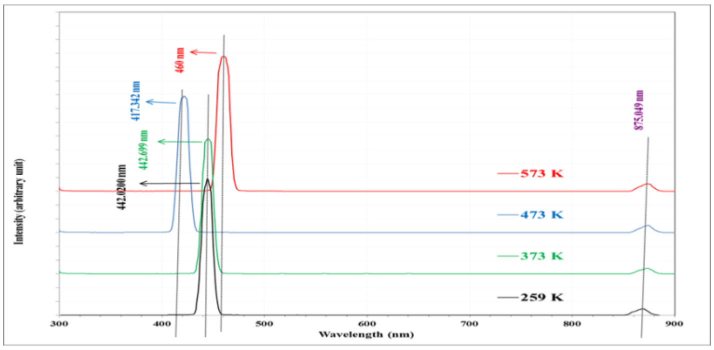
Figure (1-2): The CRC 600 magnetron sputtering system.

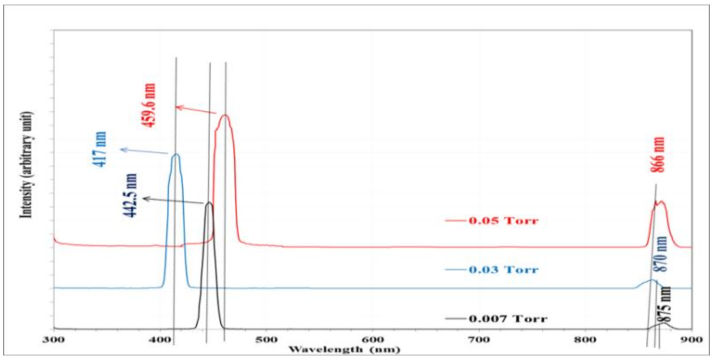
3. RESULTS AND DISCUSSIONS

Optical Properties

3.1 Photoluminescence (PL)

Figure (1-2). shows the PL spectra of V2O5 thin films deposited at various (rf power, pressure and substrate temperature), recorded at room temperature. It was the excitation wavelength 290 nm for every thin films. PL emission peaks at wavelength ranges 400 - 470 nm i.e. all absorption peaks occur in the visible region. The optical energy gap values have been calculated from the emission wavelength as in the table (1-1). The calculated energy gap values are in good agreement with those obtained from UV spectrophotometer. and agreement with reference [207,208].





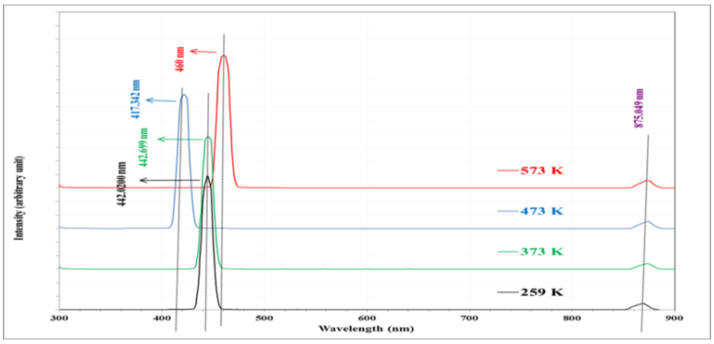


Figure (1-2): PL emission spectra of V2O5 thin films deposited at

.Different sputtering power, working pressure and temperature substrate

Table (1-1): Wavelength data and values Energy gap optical of V2O5 thin films deposited at Different sputtering power, working pressure and temperature substrate.

	Sample	**Wavelength (nm)**	**Energy gap (eV**
P(W	75	0.94410	3,023
	100	0. 45415	2,98
	152	416,036	2,98
	150	417,192	2,97
Pressure (Torr)	0.007	442,5	2,8
	0.03	417	2,9
	0.05	459,6	2,69
Temp (K)	359	442,020	2,8
	373	442,69	2,8
	473	417,347	2,9
	573	460	2,7

4. CONCLUSIONS

The optical properties of the (V2O5) thin films deposited by (RF) magnetron sputtering shows a decrement in transmission spectra with increase RF power as result of increasing films thicknesses, with decreased the energy band gap.

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