

INTERNATIONAL RESEARCH FELLOWS ASSOCIATION'S  
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Physics

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## INDEX

No.	Title of the Paper	Author's Name	Page No.
1	Study on SnO <sub>2</sub> -Fe <sub>2</sub> O <sub>3</sub> Composites as a CO <sub>2</sub> Gas Sensor	S.B. Unhale	6
2	Combustion Synthesis of a Borate Host Green Phosphor LiCaBO <sub>3</sub> :Tb <sup>3+</sup>	R. P.Sonekar, S. P. Hargunani, S. D. Kapse & R. M. Chavan	11
3	Design and EC-FDTD Simulation of a Microstrip Patch Antenna for 1950 Mhz	S. M. Palhade	15
4	Structural and Optical Properties of Antimony Trioxide Nanoparticles Prepared By Chemical Precipitation Method	M. R. Belkhedkar, R. V. Salodkar, C. C. Chaudhari, S. B. Sawarkar & A. U. Ubale	21
5	Synthesis and Humidity Sensing Investigations of Nanostructured ZnO Doped SnO <sub>2</sub> Thick Films	R. M. Agrawal & G. T. Lamdhade	25
6	One Step Galvanostatical Synthesis and Characterization of Acid Doped Pani Thin Films	Prashant P. Gedam, Gajanan A. Bodkhe, Nikesh N. Ingle, Pasha W. Sayyad & Mahendra D. Shirsat	31
7	Frequency Dependent Dielectric Studies on Ferroelectric Al-Doped KNbO <sub>3</sub> Single Crystal	Sanjaykumar H. Shamkuwar	35
8	Fabrication and Nonlinear Characterization of Pure and Nd Doped Calcium Lanthanum Borate (CLB) Glasse	G. B. Harde, A. V. Kohale & G. G. Muley	40
9	The Journey of Laser in Dermatology	S.S.Arsad	46
10	Optical Limiting Properties of Sr and Cu Doped ZnO-PVA Nanocomposites Colloidal Suspension	Y.S. Tamgadge, G.G. Muley, S.S. Arsad, N. B. Thakare & R.P. Ganorkar	50
11	Electrical Properties of Spray Deposited Zinc Selenide Thin Films	Syed Ghause Ibrahim, & Ashish V.Kadu	54
12	Evaluating The Parameters Like Radial Profile as Well as Emission of a Laser Beam on Different Electron Temperature	A. P. Pachkawade	58
13	Electrical Properties of Chemically Spray Deposited TiO <sub>2</sub> Thin Films,	Mirza I. Baig, Syed Ghause Ibrahim & S.K.Kadam	63
14	Variation of Electrolytic Current When Applied Voltage During Glow Discharge	A.P.Pachkawade & K.P.Kadam	67
15	Effect of UV Radiation on the Dielectric Properties of Salicylic Acid Doped Polymer Thin Film of PMMA	Vidhale S.G., Belsare N. G., Wadatkar A. S. & Wasnik T. S.	72
16	Study of AC Conductivity of Nano PANI-SnO <sub>2</sub> Composites	D.R. Bijwe, S.S. Yawale and S.P. Yawale	80
17	Luminescent Properties of Chemically Synthesized Bismuth Oxide	S.P. Patil & S.A. Waghuley	86
18	Structural Studies of Calcium Doped Lead Titanate	Bajpeyee A. U.	88
19	Upcoming Phototherapy Devices and Trends in the Treatment of Vitiligo	A.B.Lad & U.R.Kathale	91
20	Effect of Mixed Former on Physical Properties of Lithium Alumno Borate Glasses	D. T. Dongare & A. B. Lad	94
21	Surface Activated Cr <sub>2</sub> O <sub>3</sub> Based Thick Film for Ammonia Gas Sensing	P.M. Chandak, F.C. Raghuwanshi, S. V. Agarkar & V.D. Kapse	98
22	Comparison Between Electronic and Optical Band Gap Polyindole/Poly(Vinyl Acetate) Composite	D. J. Bhagat & G. R. Dhokane	106
23	Investigation for Optical Band Gap Energy of Polyindole/Poly(Vinyl Acetate) Composite Film	G. R. Dhokane & D. J. Bhagat,	110



24	Study of Variation of AC Electrical Conductivity of 4:1 PMMA+PS Polyblends With Constant Temperature and Varying Frequency <b>H. G. Pande, G. T. Lamdhade, R. V. Joat &amp; T. S. Wasnik</b>	114
25	Ac Conductivity And Dielectric Study of Pva Based Solid Polymer Electrolyte <b>S.R.,Jadhao, R.V.,Joat &amp; S. P. Bakde</b>	118
26	The DC Electrical Properties of Composites Polymer Electrolytes <b>S. P. Bakde, R. V. Joat &amp; S. R. Jadhao</b>	122
27	Study of Effect of ZnO on Changing Electrical Properties of Polyprrole Composites <b>Raulkar K. B., R. V. Joat &amp; Lamdhade G. T.</b>	126
28	Gamma Ray Photon Interaction Studies of Alcohol Soluble Compound At Energy 511ev <b>Mitkari S. R</b>	132
29	Effect of Oxalic Acid on DC Electrical Conductivity of Doped Polyvinylchloride and Poly(Methyl Methacrylate) Polyblends <b>A. B. Dakare, G. T. Lamdhade &amp; V. Ganesan</b>	138
30	Synthesis of Nanocrystalline Tin Oxide Doped With Copper Oxide And Study of Their Electrical Conductivity Under The Influence of CO <sub>2</sub> Gas <b>V.M.Balkhande, G. T. Lamdhade, F. C.Raghuwanshi &amp; V. Ganesan</b>	143
31	Physical Properties of Nanostructured WO <sub>3</sub> Thin Films Grown by SILAR Method <b>Ishaque Ahmed Khan &amp; R. V. Joat</b>	150
32	Study of AC Electrical Conductivity of Polypyrrole Based Composites <b>Nisha S.Bais, T.S. Wasnik , R.V. Joat &amp; G.T.Lamdhade</b>	155
33	Synthesis and Characterization of Magnesium Oxide Nanoparticles By Co-Precipitation Method <b>A.B.Daware, G.T. Lamdhade, T.S. Wasnik, V. Ganesan &amp; M. N. Pawar</b>	159
34	FTIR of Alq <sub>3</sub> : Eu <sup>2+</sup> Organic Nanophosphor <b>Sunil A. Bhagat</b>	162
35	Rapid Growth of 0.4% Leucine Doped Ammonium Dihydrogen Phosphate (ADP) Single Crystal <b>B. A. Shingade, R. M. Belekar &amp; K. G. Rewatkar</b>	166
36	Characterization of Nanostructured CoS Thin Films With And Without Using Complexing Reagent Grown By (SILAR) Method <b>A.V.Mitkari, A.U. Ubale &amp; M.Lokhande</b>	173
37	Detection of Carbon Dioxide Using Conducting Polymer Polypyrrole and Polyaniline <b>Mude B.M.,Mude K.M., ZadeR.N., Yenorkar S.M Yawale S. P., Yawale S.S. &amp;Raulkar K.B.</b>	180
38	Porous Silicon as a Cl <sub>2</sub> Gas Sensor at Room Temperature With Different Current Densities <b>Y.S.Sakhare, R.E.Khadse &amp; S.G. Kalane</b>	186
39	Molecular Interaction of Aqueous LiOH.H <sub>2</sub> O in DMSO at Different Temperatures <b>A. A. Mistry</b>	191
40	Structural and Analytical Applications of Copolymers Derived from 4,4'-Dihydroxy Biphenyl <b>Vijay. R. Chinchamalature &amp; Bhagwat D. Ridhorkar</b>	196
41	Synthesis and Characterization of Proton Conducting Composite Solid Polymer Electrolyte System <b>R.Risodkar &amp; R. Joat</b>	203
42	Synthesis of 2-Substituted Benzoxazole from Aryl Diazonium Salt Using Magnetically Separable Catalyst <b>Ramesh N Zade , Kushal M.Mude, &amp; Bhupesh M. Mude</b>	209
43	UV-Visible Luminescence of M <sub>2</sub> CaSiO <sub>4</sub> :Tb <sup>3+</sup> (M=Li, Na, K) Green Phosphors for Pdps Application <b>P.P. Bhure, &amp; S.P. Puppallwar</b>	214
44	Molecular Interaction Study of Ternary Liquid Mixture of Alcohol + Tea + formic Acid Through Excess Viscosity and Excess Compressibility <b>P. J .Thakare</b>	221
45	Synthesis and Thermal Investigation of Graphene from Natural Graphite Flakes <b>C. L. Tumbade and G. R. Dhokane</b>	225
46	Synthesis and Structural Characterization of Cadmium Oxide(CdO)-Magnesium Oxide (MgO) Nanocomposite by Sol Gel Method <b>Rajikshah Chandshah , V.D.Kapse &amp; V. S. Kalyamwar</b>	230





47	Synthesis of Cadmium Doped Indium Oxide by Combustion Method P.M. Chatare & V.D. Kapse	234
48	Fabrication and Characterization of Pure and Surface Modified Nanocrystalline CdSnO <sub>3</sub> for Gas Sensing Manisha S. Pande , V. D. Kapse & V. S. Kalyamwar	237
49	Synthesis and Structural Characterization of CdSe Thin Film by Homemade Spray Pyrolysis Technique Arvind D. Kanwate & E.U.Masumdar	242
50	Investigations of Polymer Blends: Variation of Conductivity and Dielectric Constant Versus Frequency P.P.Raut, G. T. Lamdhade, F. C.Raghuwanshi, K. B. Raulkar, T. Shripathi & V. Ganesan	246
51	Water Vapour Sensing Mechanism of PANI Doped With ZnO Nanocomposites T R Ingale, R M Agrawal , G T Lamdhade, F C Raghuwanshi, K. B. Raulkar & V. Ganesan	250
52	Study of AC Electrical Conductivity and Dielectric Properties of Polypyrrole Based ZnO Nanocomposites T S Wasnik, R M Agrawal, K B Raulkar, G T Lamdhade & R V Joat	254
53	Effect of Deposition Rate on The Structural and optical Properties of Copper Sulphide Thin Films S. S. Kawar ,S.V. Potdar, V.S. Kalyamwar, A. P. Pachkawade & G.T. Lamdhade	259
54	CuO Modified ZnO Thick Film Resistors As H <sub>2</sub> S Gas Sensors V. S. Kalyamwar, S. S. Kawar, S. V. Potdar & F. C. Raghuwanshi	264
55	Gas Sensing Study of SnO <sub>2</sub> -ZnO (90-10) Nanocomposite Towards H <sub>2</sub> S S.G.Onkar, F.C.Raghuwanshi, G.T.Lamdhade & S.D.Kapse	271
56	Optical limiting in Sr and Cd doped CuO-PVA nanocomposites colloidal suspension under 808nm CW excitation, Y. S. Tamgadge, G. G. Muley, M. A. Mahure, P. P. Gedam, A. L. Sunatkari	280
57	Goldstone Mode fluctuations of ZnO Nanoparticles , G.T.Lamdhade	284
58	Fabrication and Application of Polyprrole (PPy)-ZnO composites to sense NH <sub>3</sub> gas at room temperature K. B. Raulkar	289
59	Effect of Lithium Salt on Electrical Properties Polythiophene Polymer Composite P. D. Shirbhate, S. P. Yawale ,S.V. Pakade	295
60	Development of CO <sub>2</sub> Gas Sensor Based On Polyaniline – SnO <sub>2</sub> D.R. Bijwe, S.P. Yawale, G. T. Lamdhade	300
61	Synthesis and Thermoluminescence Study of Manganese Doped Calcium Sulfate Phosphor Z. S. Khan, N. B. Ingale, S. K. Omanwar	305
62	Student's knowledge and attitude towards Renewable energy sources and their uses S. S. Mankar	311
63	Combustion Synthesis and VUV Photoluminescence of Phosphate Host Phosphor Ba <sub>3</sub> La(PO <sub>4</sub> ) <sub>3</sub> : Eu <sup>3+</sup> · J. T. Ingle, D.Y.Dhale, R.T.Parihar, R.P.Sonekar, S.K.Omanwar	315

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*- Chief & Executive Editor*





## Synthesis and Structural Characterization of Cadmium Oxide(CdO)- Magnesium Oxide (MgO) Nanocomposite by Sol Gel Method

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### Abstract :

*A resistive material CdO-MgO nanocomposite was developed by sol gel method. X-ray diffractometer confirms the formation of CdO-MgO nanocomposite phase having average crystalline size 64.2 nm . Spherically shaped grains and surface structure of CdO-MgO had revealed in Field emission scanning electron which having size 30.62 nm range. Energy Dispersive spectroscopic analysis confirms presence of Cd,Mg and O element with concentration 23.9 %, 27.1 % and 49 % in weight percentage respectively. Fourier transforms infrared spectroscopy absorption peak also confirm the CdO-MgO nanocomposite formation. CdO-MgO may use for gas sensing application which may useful for civilian and industry.*

**Keywords :** nanocomposite, cadmium oxide, magnesium oxide, analysis

### Introduction :

There are numerous application of CdO like gas sensing and photosensitive application because of band gap of CdO is 2.5.eV and CdO is n-type conductor. Now a days CdO is modifies for enhancing structural and morphological properties. CdO-ZnO is use for Photocatalytic activities[1]. Zinc Oxide (ZnO)-Cadmium Oxide (CdO) nanocomposite has been synthesized by reverse microemulsion method and used as adsorbent to remove methyl blue from aqueous solution [2]. CdO-ZnO is used for ethanol sensing due to its modified properties [3,4]. Selective and sensitive Bilirubin sensor are develop using CuO-CdO nanocomposite and practically implemented in real sample applications [5]. Gas sensing properties of MgO modified LaFeO<sub>3</sub> was studied [6]. MgO:TiO<sub>2</sub> developed for methane gas sensing application and it shows good response to methane gas [7].

From last few decades, Semiconducting Metal Oxide (SMO) gas sensors have grow to be a prime technology in numerous industrial, domestic and commercial gas sensing application. Now a days gas sensors are mostly available into three different types of solid state[8-9]. These sensors are derived from catalytic combustion, electrochemical behaviour, or resistance modulation of SMO [10-17]. Due to advantages such as small size, low cost , durability, measurement simplicity, low detection limits (< ppm levels) and ease of fabrication in SMO gas sensor device over the methods of sensing methods. Nanocomposites based on CdO have become familiar for gas sensing technology [18-20]. CdO-MgO is synthesized for structural and morphological studies, may be having the excellent properties for gas sensing application.

### Experimental

Cadmium nitrate Hexahydrate from sdfine with AR grade and Magnesium nitrate hexahydrate from Merk with emplura grade were taken as source for synthesis while ethanol ,water and alcohol is used as solvent to dissolve. For rigidity to gel network PVA (Polyvinyl alcohol) is used. Drying temperature is 110 °C and time for drying is 24 h. While synthesised solution was stirred by magnetic stirrer with Teflon coated magnetic paddle.

Ethanol is mix with distilled water and stirred up to 15 min with magnetic stirrer to get homogenous solution. Appropriate quantity of Cd(NO<sub>3</sub>)<sub>2</sub>.4H<sub>2</sub>O, Mg(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O and PVA were

weighted by using electronic balance separately. Cadmium nitrate and Magnesium nitrate were added to solution and stirred continuously after that PVA added to solution and stirred continuously up to 2 h. Viscous gel of solution was formed then kept in furnace for 24 h for drying. Obtained product was calcined at 550 °C in silica crucible. It is crushed with mortar and pestle to obtained fine powder of CdO-MgO nanocomposite.

### Results and discussion

Fig.1 shows X-Ray Diffractometer (PANalytical Xpert Pro Cu K $\alpha$ - 1.54 Å) pattern of synthesized CdO-MgO powder sample. Characteristic peak of CdO-MgO have higher intensity shows crystalline nature of sample. Observed peak in XRD pattern are matching well with peak of JCPDS card no. 00-005-0640 (Monteponite-CdO) and 01-074-1225 (Periklase-MgO). From Debye Scherrer's Formula, average crystalline size of CdO-MgO nanocomposite is 64.2 nm. Crystallinity of prepared CdO-MgO nanocomposite is found to be 75.78 percentage.

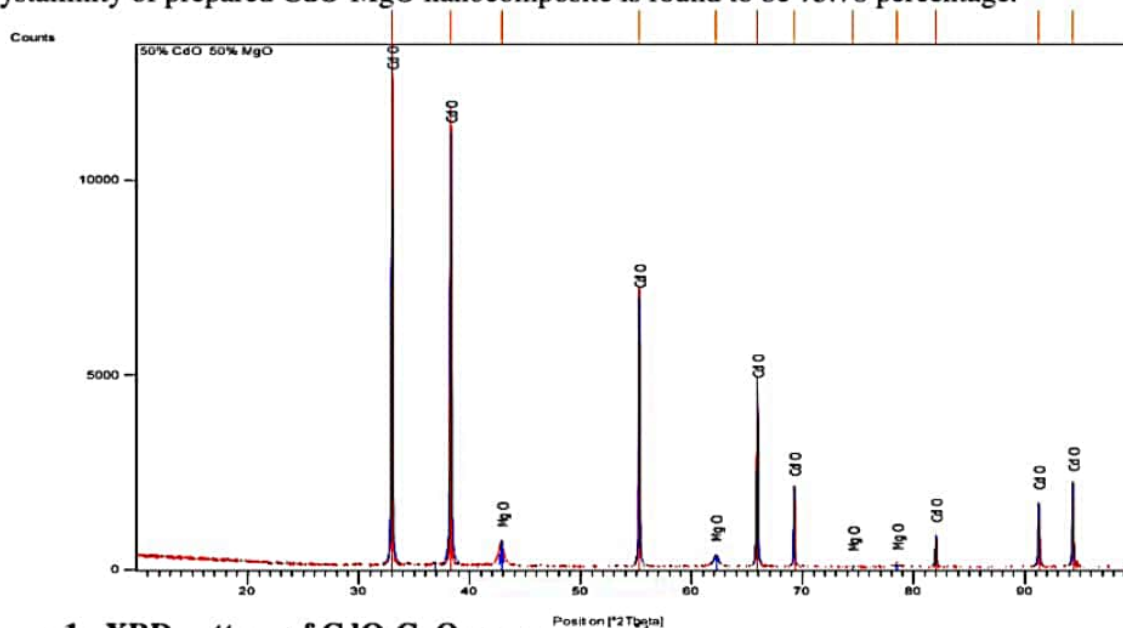
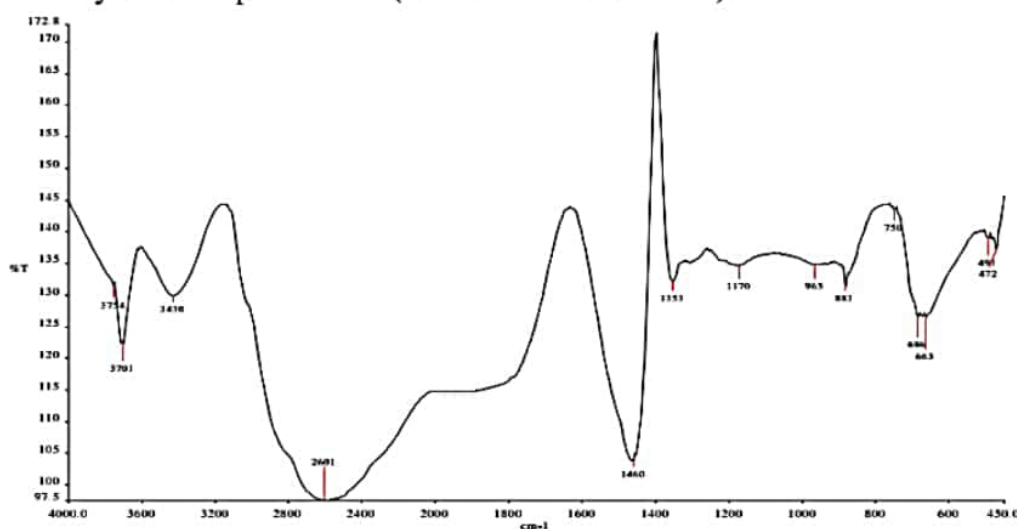


Figure 1: XRD pattern of CdO-CuO nanocomposite.

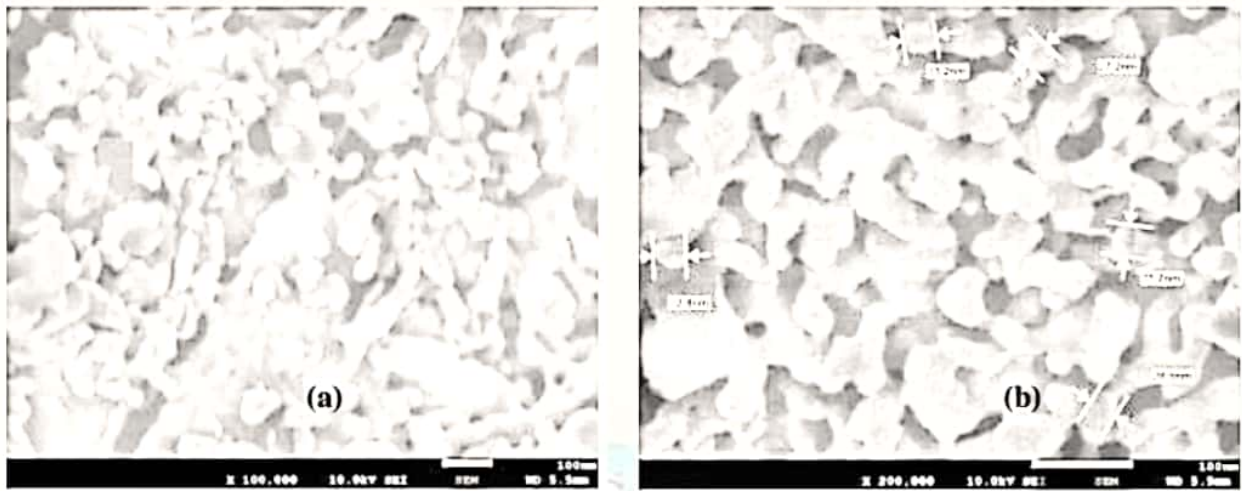
CdO-MgO nanocomposite was mixed with KBr powder and Fourier Transform Infrared Spectroscopy (FTIR) spectra was measured. FTIR assessment from fig. 2 was performed in region of 450 to 4000 cm<sup>-1</sup> under normal condition of the solid CdO-MgO nanocomposite was recorded by FT-IR Spectrometer (Perkin Eimer instrument).





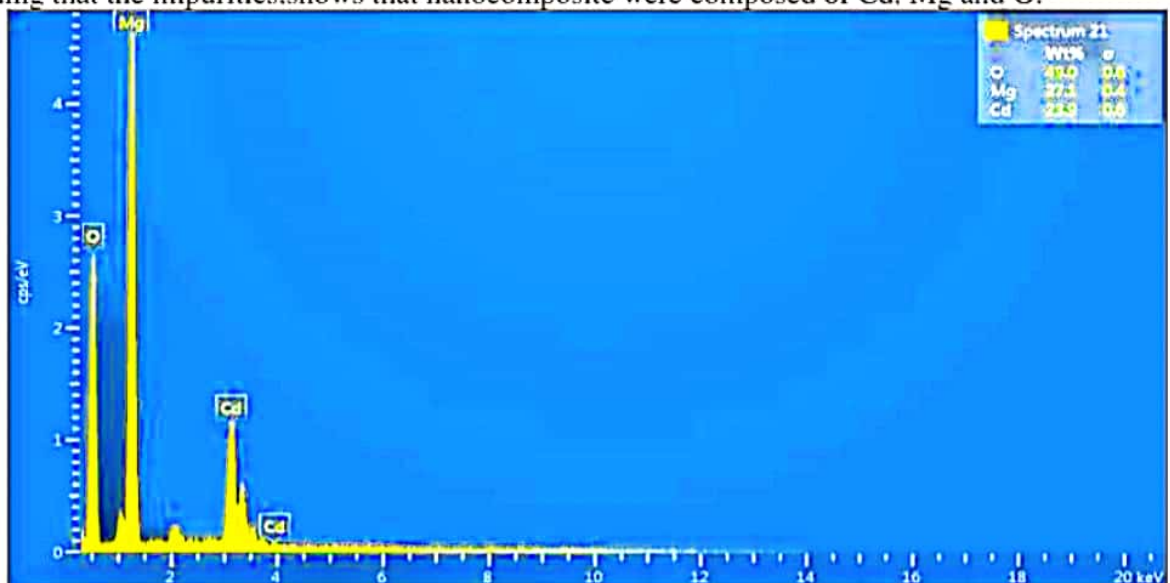
**Figure 2:** Fourier Transform Infrared detector FTIR spectrum of CdO-CuO nanocomposite.

Field Emission Scanning electron microscope (FESEM) is great application for analyse the morphology of CdO-MgO nanocomposite. Basic nature and morphology of synthesized CdO-MgO nanocomposite was observed by FESEM (JEOL JSM7610F) equipped EDS (Oxford). Typical Surface micrograph of CdO-MgO nanocomposite were examined at low to high magnified range ( Fig. 3 a-b ). Crystalline size of CdO-MgO nanocomposite was measured from FESEM images in range of 27.2 to 32.8 nm. Crystal shape of CdO-MgO aggregated nanostructural material were displayed in FESEM images. FESEM images clearly indicate that prepared material is nanocomposite of CdO-MgO, which is revealed in standard shape nanostructures.



**Figure 3:** FESEM microstructure for (a) CdO-MgO microstructure at 100000 magnification, (b) CdO-MgO microstructure at 200000 magnification with grain size measurement

Synthesize material show presence of Cadmium (Cd), Magnesium (Mg), and Oxygen which is based on the Energy Dispersive Spectroscopy (EDS) of Oxford company analysis. Nanocomposite having concentration of Cd, Mg and O in weight percentage 23.9, 27.1 and 49.0 respectively (Fig. 4). Prepared material is so pure that there is no any additional peaks reported regarding that the impurities. shows that nanocomposite were composed of Cd, Mg and O.



**Figure 4 :** EDS spectrum of CdO-CuO nanocomposite.



### Conclusions

CdO-MgO nanocomposite was prepared successfully by using sol gel pyrolysis method. In XRD analysis, observed peak are well matches with CdO and MgO peaks, so it indicate that material composed of CdO-MgO nanocomposite. As sharp peak develop in material shows excellent crystalline nature having crystallinity 75.78 percent. Average crystalline size is 64.2 nm which indicate nanostructured nature of material. FTIR spectrum shows that observed absorption peak of CdO and MgO composite. When analyse with FESEM, particle are in nano meter range with crystal structure and standard shape. EDS report suggest that material include Cd , Mg and O element only. Due to characteristic and morphological properties, synthesized material may be use for gas sensing.

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