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OPTICAL CHARACTERIZATION OF CALCIUM OXIDE NANOPARTICLES

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ABSTRACT

Copper oxide nanoparticles were prepared by co-precipitation method. Using calcium chloride as a precursor and NaOH as a regent. The CaO nanoparticles were prepared at different molarities annealed at 50 C. This gives a large scale production of CaO nanoparticles easily. optical properties of CaO nanoparticles were studied with the help of XRD studies, UV spectrum analysis and FTIR analysis. Particle size increases with increase in molarity. The band gap energy decreases with increase its molarity.

Keywords: Calsium Oxide Nanoparticles, Co-Precipitation, FTIR,UV,XRD

I INTRODUCTION

Nano materials possess the properties intermediate bulk and molecule. CaO are the most studied materials for their interesting properties. So it becomes a very important topic in the ongoing research activity across the world. This Nano particle has wide range of applications in all field. Nanoparticles of CaO have much attention due to its wide applications such as marble, chalk, coral, cement and glass as building materials, paints, pulb, paper, medicine. The characterization of the samples were carried out using X-ray diffraction, FTIR studies and UV analysis. Form these studies we can studied the optical properties of CaO nanoparticles.

II EXPERIMENTAL DETAILS

2.1 Preparation of Sample

CaO nanoparticles were prepared by adding a solution of $CaCl_2$ and NaOH in distilled water.The mixer was strirrer at 3hours in magnetic strirrer.The above solution were heated at 50 C .The formed precipitate was filtered and dried and thoroughly grind using agate mortar to obtain the samples in the form of fine powder.This procedure was done at different molarities. The formed samples were analyzed using XRD, FTIR, and UV analysis.

2.2 Characterization of Cao Nanoparticles

2.2.1 .XRD Analysis

X-ray powder diffraction is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. It is a technique used for determining the atomic

and molecular structure of a crystal, in which the crystalline atoms cause a beam of incident X-rays to diffract into many specific directions.

2.2.2. FTIR Analysis

Fourier Transform Infrared Spectroscopy, also known as FTIR Analysis or FTIR Spectroscopy, is an analytical technique used to identify organic, polymeric, and in some cases, inorganic materials. The FTIR analysis method uses infrared light to scan test samples and observe their properties. It is to measure how well a sample absorbs light at each wavelength. The most straight forward way to do this, the "dispersive spectroscopy" technique, is to shine a monochromatic light beam at a sample, measure how much of the light is absorbed, and repeat for each different wavelength.

2.2.3. UV Analysis

Ultraviolet–visible spectroscopy or ultraviolet-visible spectrophotometry refers to absorption spectroscopy or reflectance spectroscopy in the ultraviolet-visible spectral region. This means it uses light in the visible region. The Beer-Lambert law states that the absorbance of a solution is directly proportional to the concentration of the absorbing species in the solution and the path length.[3] Thus, for a fixed path length, UV/Vis spectroscopy can be used to determine the concentration of the absorber in a solution. It is necessary to know how quickly the absorbance changes with concentration.

III RESULTS AND DISCUSSION

3.1 XRD Analysis

XRD pattern of the prepared samples are taken with the wavelength 1.54069 A^0 unit. From this we determine the size of the synthesized nanoparticles. The XRD data tableof CaO nanoparticles as shown in table (1) and table (2).

d value	2 theta
4.90630	18.066
3.11059	28.676
2.6270	34.101
2.4531	36.601
1.9262	47.144
1.7959	50.798
1.6864	54.798
1.6354	56.199
1.4825	62.60
1.3135	71.80
1.2091	79.14
1.1410	84.919
1.0602	93.195

Table(1)

d value	2 theta
4.9240	18.00
3.1142	28.640
2.6319	34.036
1.9313	47.01
1.7979	50.73
1.6889	54.27
1.6413	55.97
1.484	62.51
1.315	71.65
1.212	78.90
1.144	84.57
1.061	93.00
1.037	95.81

Table(2)

Prepared samples confirm the cubic structure of CaO and these result were matched with JCPDS card.The crystal size was calculated using Debye Scherrer's formula. The results found to be 25 nm for 0.2 M and 42nm for 0.5 M samples. If the molarity of the particle increased the size of the nanoparticles also increased.

3.2 FTIR Studies

FTIR Spectroscopyata table of CaO nanoparticles at 0.2 M and 0.5 M samples as in table(3) and table(4).

Peak	Intensity
875.68	61.40
1.012.63	67.03
1456.26	54.68
1651.07	86.24
2067.83	72.92
2827.64	92.51
3691.75	59.74

Table (3)

Peak	Intensity
864.11	54.64
1018.41	60.86
1411.89	47.70
2063.83	83.50
2831.50	92.25
3635.82	70.00
3701.40	81.31

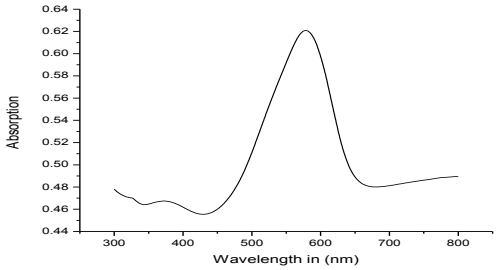
Table(4)

At 0.2 M sample, the sharp peaks at 3691 cm^{-1} and 2827 cm^{-1} are in O-H stretching. It shows the water is present.2067 cm^{-1} shows the Ca-OH stretching. The peaks 906 cm^{-1} and 871 cm^{-1} is assigned to the Ca-O stretching it shows the water is present. At 1012 cm^{-1} and 875 cm^{-1} peaks shows the Ca-OH and Ca-O stretching vibration respectively.

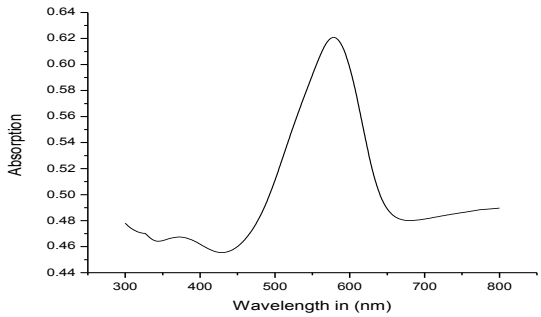
At 0.5 M sample, the peaks at 3701 cm^{-1},3635 cm^{-1} and 2063 cm^{-1} are in O-H stretching it shows the water is present.At 1411 cm^{-1} and 864 cm^{-1} peaks shows the Ca-OH and Ca-O streaching. From this result transmittance increases with increase of molarity.

3.3 UV Spectral Studies

The most dramatic property of semiconductor nanoparticles is the size evaluation of optical absorption spectrum of CaO.Fig(1) and fig(2) are shows the 0.2 M and 0.5 M of UV visible absorption spectrum.



Fig(1)



Fig(2)

The recorded graph between absorption versus wavelength for prepared samples. It has been found that firstly the absorption decreases sharply with increase in wavelength.The energy band gap of the prepared samples was estimatted. The calculated band gap value of prepared samples are 2.168 ev and 2.149 ev at 0.2 M and 0.5 M samples respectively.It might be due to quantum confinement effect.ie increase in crystalline size ,the decrease in band gap, because the crystal lattice expands and the interatomic bonds are weaked.Weaker bonds means less energy is needed to break a bond and get on electron in the conduction band.

IV CONCLUSION

CaO nanoparticles were prepared by co-precipitation method.The crystallite size of synthesized nanoparticles prepared at 0.2 M and 0.5 M was estimated by using Debye-scherrer formula.The observed size 25 nm and 42 nm.It was observed to increase with increase of molarity.

FTIR spectra of CaO nanoparticles show the stretching mode of Ca-O nanoparticles.

The energy band gap of the prepared samples was given by 2.168 ev and 2.149 ev .It might be due to quantum confinement.ie. increase the crystal size with decrease the bandgap energy.

From absorption spectroscopy results,it has been found that firstly the absorption decreases sharply with an increase in wavelength near the band edge 380 nm indicating the formation of nanostructure samples and thereafter the value of absorption coefficient becomes more or less constant indicating the uniformity of size of synthesized nanoparticles.

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