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Synthesis and Characterization of Nickel OxideNanoparticles

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Abstract

The Nickel Oxide Nanoparticles were prepared by sol-gel technique.Structural and optical properties of the nanoparticles were studied. The crystallite size of the synthesized nanoparticles was attained from X-ray diffraction and found to be 11nm. FTIR confirmsthe presence of NiOparticle. Optical band gap is found to be 3.69 eV

Keywords*: Nano particles, nickel oxide, sol-gel method prepared*

Introduction

Metal oxides are the metallic compounds designed with the help of oxygen and metal with the arrangement of oxide ions. Now a day, Nickel oxide develops one of the most usually considered material as of its actual fascinating properties like catalytic, electrical, magnetic and anti-ferromagnetic properties etc. [1]. NiO is adaptable, economical, attracts unambiguous interest due to its high thermal/chemical stability, high precise capacitance, ecologically kind nature, concrete availability and it is also most stable metal oxide among all transition metals [2-4]. Further, due to comprehensive range of uses in dissimilar fields, Nano size and bulk Nickel oxide (NiO) have received significant interest, such as: electrochromic films [5-7], gas sensors, magnetic materials [8-10], fuel cell electrodes, photovoltaic devices [11], smart windows [12], catalysis, electrochemical super capacitors [13], dye-sensitized photocathodes [14]. Synthesis of Nickel Oxide Nanoparticles has a growing significant scientific and technological attention from last few years and it is upgraded due to its smaller size due to which so many applications

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exhibits. Therefore, Synthesis of Nanoparticles of Nickel oxide by various methods has always been an important fact in which crystal structure and the size of particles has been measured.

Synthesis of Nio Nanoparticles:

By using sol-gel procedure the Nanoparticles of Nickel oxide were prepared.1.5gof $NiCl_2.6H_2O$ was dissolved into a 70 ml of pure ethanol, leading to the formation of green coloured solution. After this NaOH solution was added dropwise to prepared solution to form proper precipitates and for proper mixing, the solution was kept for stirring. After 2 hours stirring, a green coloured gel was formed. The prepared gel was filtered and washed thoroughly two or three times with deionized water and ethanol. Then green coloured gel was kept for drying at room temperature until a light green powder was formed. At last, the obtained powder was kept into a crucible and subjected for calcination at 290^0c. Keeping the green powder maximum for 30 minutes in a furnace leads to a black powder [15].

XRD (X-RAY DIFFRACTION):

The XRD pattern of the Nickel Oxide nanoparticles as shown in fig. 1 displays the discrete peaks at angle $2\theta = 37.4°$, 43.4°, 63.1° and 75.5° corresponds to (002), (111), (200), (220) and (222) with no impurity peak as confirmed from JCPDS file no. 04-0835. The observed peaks having high intensity which shows that the prepared NiO nanoparticles are of good crystallinity. The average crystallite size of these Nanoparticles calculated with the help of Scherer formula was found to be 11 nm. [16]

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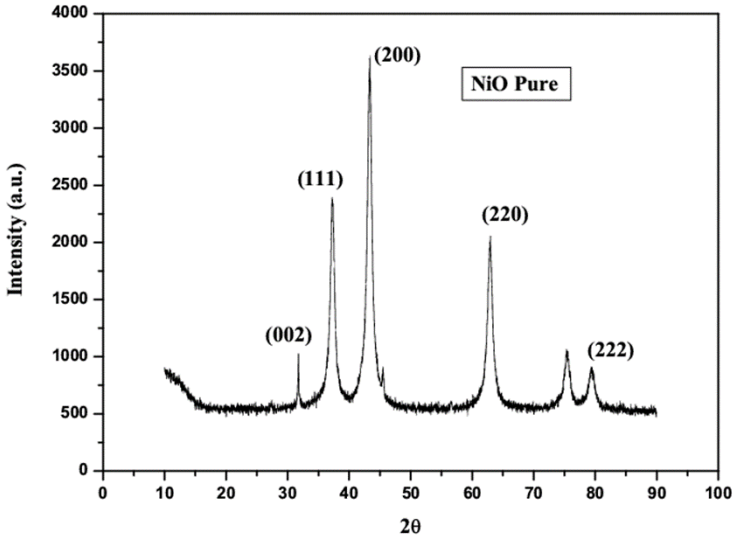

Figure 1:XRD pattern of pure NiO nanoparticles.

FTIR

The fig. 2 shows FTIR spectra of the particles in the range of 500- 4000 cm^{-1}. The Fourier Transform Infrared spectrum of NiO Nanoparticles exhibited substantial peaks at 3571, 2333, 1620,719 and 449 cm^{-1}. The broad peak is allocated to the O–H stretching vibration at 3571 cm^{-1} and at 1620 $cm^{-1}$is weak band allocated to H–O–H bending vibration mode might be due to the moisture adsorption. The strong band at 449 $cm^{-1}$is ascribed to the Ni-O stretching, but at 719cm^{-1} absorption bond was allocated to Ni-O-H stretching bond.[16, 17].

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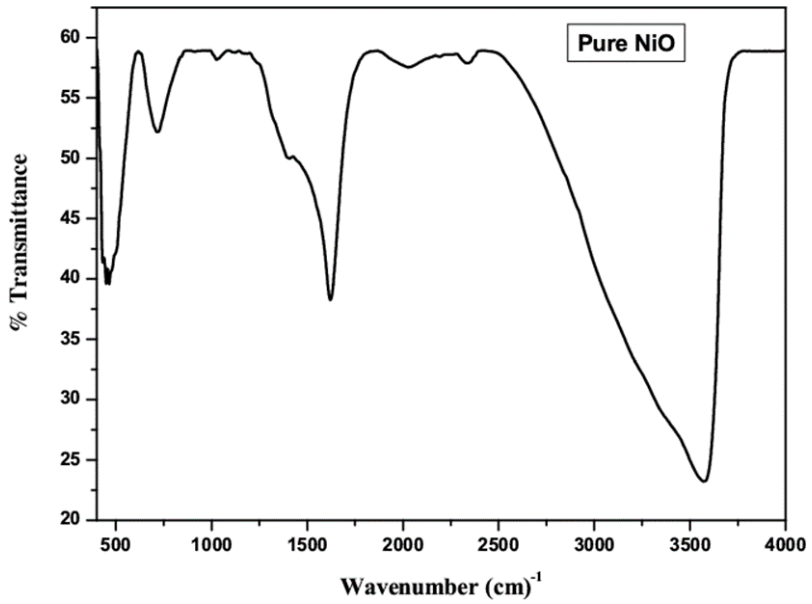

Figure 2: FTIR Spectra of NiO Nanoparticles.

Optical Study

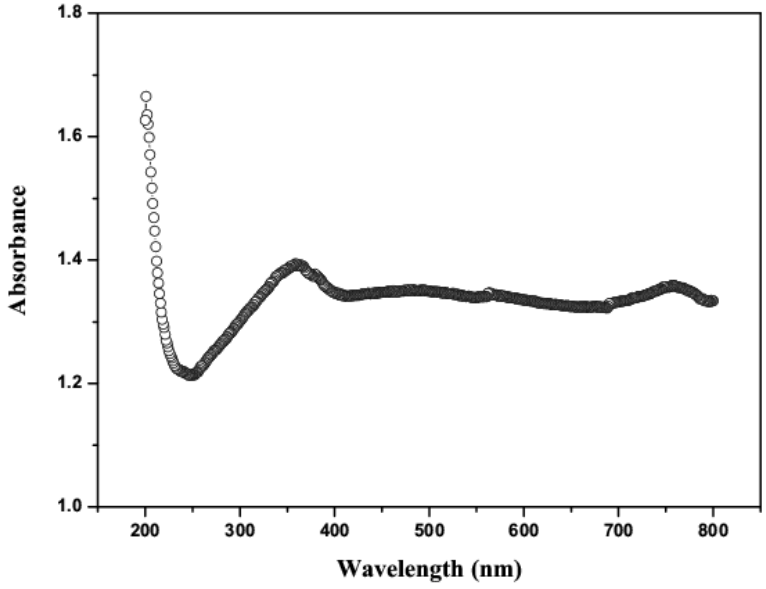

Figure 3: Absorbance spectra of NiO Nanoparticles.

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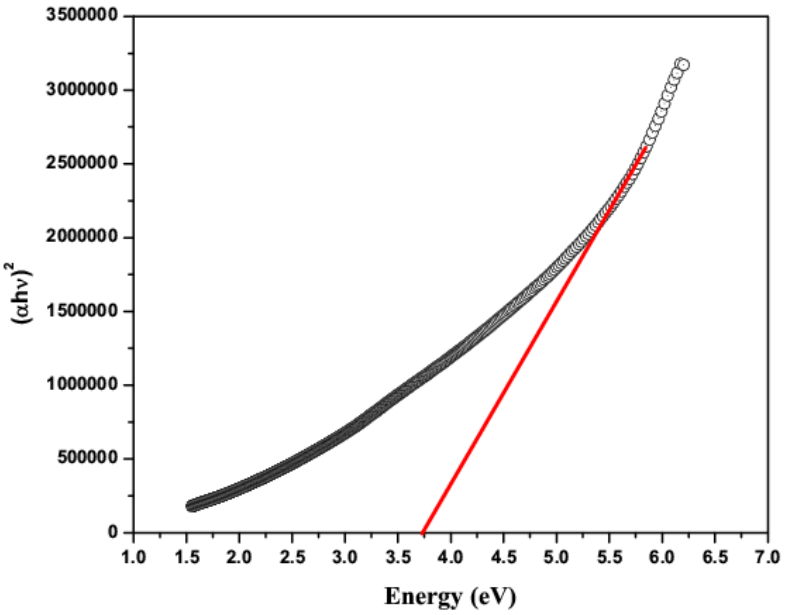

Figure 4: Energy bandgap of NiO Nanoparticles.

Fig. 3 shows the absorbance spectra of Nickel Oxide nanoparticles.At wavelength of about 350 nm a steep rise in the absorption has been observed, which is ascribed to the transition of the electron from valance band to conduction band in NiO[16].The band gap energy can be calculated with the help of equation which is given below, $(\alpha h\nu)^2 = (h\nu - E_g)$Where, α - coefficient of absorption, hv- photon energy, Eg is the bandgap and n is ½ and 2 for indirect and direct transitions, respectively.We also notice here that these nanoparticles almost transparent in visible region. The value of the bandgap is found to be 3.69eV [18].

Conclusion:

NiO nanoparticles were magnificently synthesized by using sol-gel method. XRD confirms that prepared particles are of NiO with cubic structure having crystallite size of about 11 nm. UV-VIS analysis shows that energy band gap of the sample comes near about 3.69eV

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