

# Synthesis and Morphological Study of Nickel Oxide Nanoparticle

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**Abstract:** Nickel oxide (NiO) nanoparticles have been successfully synthesized by sol-gel method using ascorbic acid was used as a reducing reagent and ethylene glycol as a sol stabilizer and also served as a diffusion barrier. The characterization has been done with XRD, TEM, FTIR, and UV-Vis Spectroscopy. The particle size was determined from X-ray diffraction which was also confirmed by TEM. The band gap energy was calculated by UV-Vis-NIR and structural property by FT-IR spectroscopy. The results obtained from the study confirm the formation of nickel oxide nanomaterial with the particle size of 25 nm.

**Keywords:** NiO, Sol-Gel Method, Band Gap

## I. INTRODUCTION

From the past few years, researchers are attracted to the development of nanomaterial due to their excellent chemical, electrical and optical properties [1,2]. Hence, nanomaterials are widely used in photocatalysis [3], removal of toxic metals [4], photoelectrochemical cells [5], dye-sensitized cells [6], gas sensors [7], and electrochemical sensors [8]. One of the important factors of a nanoparticle is their synthesis with easy method, green chemistry, using cheap chemicals, and so on. This preparation can be done with different synthetic methods like sol-gel methods, hydrothermal, microemulsion, precipitation, microwave, etc. which led to the preparation of special engineering material [9,10]. Nowadays, many efforts have been concentrated on the synthesis of metal oxide nanomaterial due to its outstanding properties as compared to bulk materials. The properties of nanomaterial are different from bulk one is due to its nature of atomic structure in the interfacial regions of the nanoparticle.

Nickel oxide is a NaCl-type antiferromagnetic oxide semiconductor with p-type conductivity films due to its wide band-gap energy range from 3.6 to 4.0 eV [11]. It is difficult to prepare size-homogeneous and well-dispersed NiO nanoparticles with lesser particles size. The commonly used nickel salts are nickel acetate, nickel chloride, nickel sulphate, nickel nitrate, and nickel citrate. Estelle et.al [12] studied the effect of these salts on the properties of NiO nanoparticles and reveals that nickel acetate precursor forms reduced NiO having high surface area and sponge morphology. Wang et al [13] prepared NiO nanocrystalline with an average particle diameter of 18–55 nm using a surfactant-mediated reagent.

In this paper, we disclose a simple method for the synthesis of well dispersed, sphere-shaped, highly stable nickel oxide nanoparticles by sol-gel method and found that the use of alkaline ascorbic acid in glycol atmosphere successfully formed the nickel oxide nanoparticles.

## II. EXPERIMENTAL

### 2.1 Materials and Methods

All chemicals used were of analytical reagent grade purchased from Merck. Doubly distilled water was used throughout Fourier- Transform Infrared (FT-IR) were recorded at a range of 4000-400 cm<sup>-1</sup> using a Shimadzu FTIR Spectrometer. The crystal structure was studied by a Bruker D8 advance X-ray Diffractometer at UGC-DAE