SYNTHESIS AND OPTICAL STUDIES OF NICKEL DOPED CERIUM OXIDE ($NiCeO_2$) NANOPARTICLES

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Improvising nanoparticles and manipulating the nanoparticles are trending works revolving around the world in this era of science. Here in this paper we are investigating the doping of nickel in cerium oxide, in which synthesizing nanoparticles tends to have higher magnetic nature since the nickel exhibits ferromagnetic character, its properties develop based on the concentrations of nickel involved together with cerium oxide. This investigation helps to understand the concentration of doping and its structural and optical changes, characterizing through XRD-JCPDS data.

KEYWORDS: Nano, doping, magnetic, Ni-CeO_2

I. INTRODUCTION:

Nanomaterials are getting in to higher throttle of successful rates for the past twenty to twenty-five years due to their overwhelming higher efficiency working methodologies with better retuning the old ideas of innovation and creating the fresh approaches in the scientific revolution globally. Synthesisation, characterization and critical analyzation of properties are the trending developments in the nanoworld. The Solution combustion synthesis (SCS) is an effective method for the synthesis of nanoscale materials and has been used in the production of various ceramic powders for a variety of advanced applications.

The properties of the resulting powders (crystalline structure, amorphous structure, crystallite size, purity, specific surface area and particle agglomeration) depend heavily on the adopted processing parameters. The research activities related to this area were driven by the ability to control material properties by controlling the size of the particles.

Here in this paper we are investigating doping concentrations of a materials and its impact on the compounds of nanoparticles, various categorical investigations helps us to critically conclude the parameters of changes involved in it.

Generally, the particle size and morphology of synthesized nanoparticles obtained at different laser energies were investigated by field emission scanning electron microscopy (FE-SEM). The optical property of synthesized nanoparticles was carried out using UV-visible spectroscopy. The structure of the synthesized nanoparticles was investigated using X-ray diffraction (XRD) technique.

II. OBJECTIVE OF THE STUDY:

[1] Synthesizing Nickel Doped Cerium Oxide.
[2] Determining its structural changes.
[3] Authenticating the parameters validation with JCPDS data.

III. METHODOLOGY:

In this method of "Synthesisation" was done by Combustion technique where nickel nitrate, cerium oxide, succinic acid and urea introduced in to high hot furnace which doesn't disturbed due to external surroundings. Furtherly these particles are introduced in to annealing process too. By this nanoparticle are

synthesized in a restricted and controlled conditions manner. Solution combustion synthesis (SCS) is an effective method for the synthesis of nanoscale materials and has been used in the production of various ceramic powders for a variety of advanced applications.

IV. EXPERIMENTAL SETUP:

This "Synthesisation" Process has been carried out using closed hot furnace where the 1:2 molar concentrations of nickel nitrate and cerium oxide has been deployed for 500° C for the surface volume ratio decreasing process for nanoparticle configuration and it has been annealed with 200° C for nine hours for the eradicating unwanted bonds to get crystalline nature of synthesized material (compound). These materials highly magnetic in nature due to its O^- mobility.

V. FIGURES:

Fig 1: The mixture boils foams and ignites to burn with flames to yield voluminous foamy Ni doped cerium Oxide.

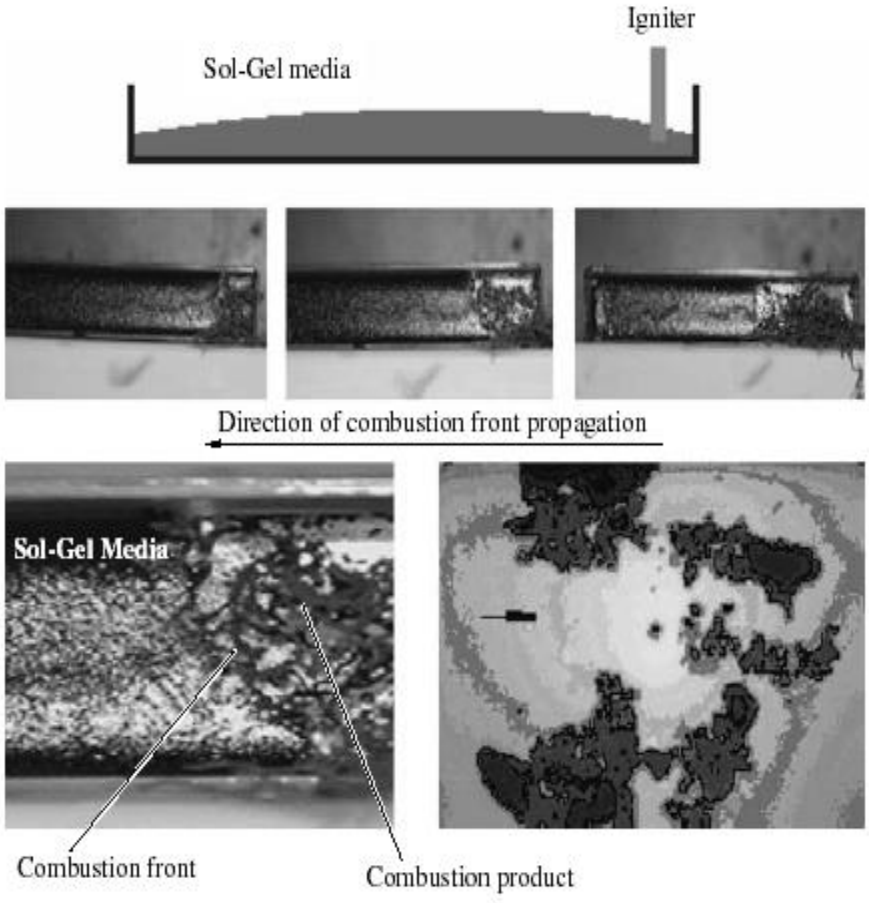
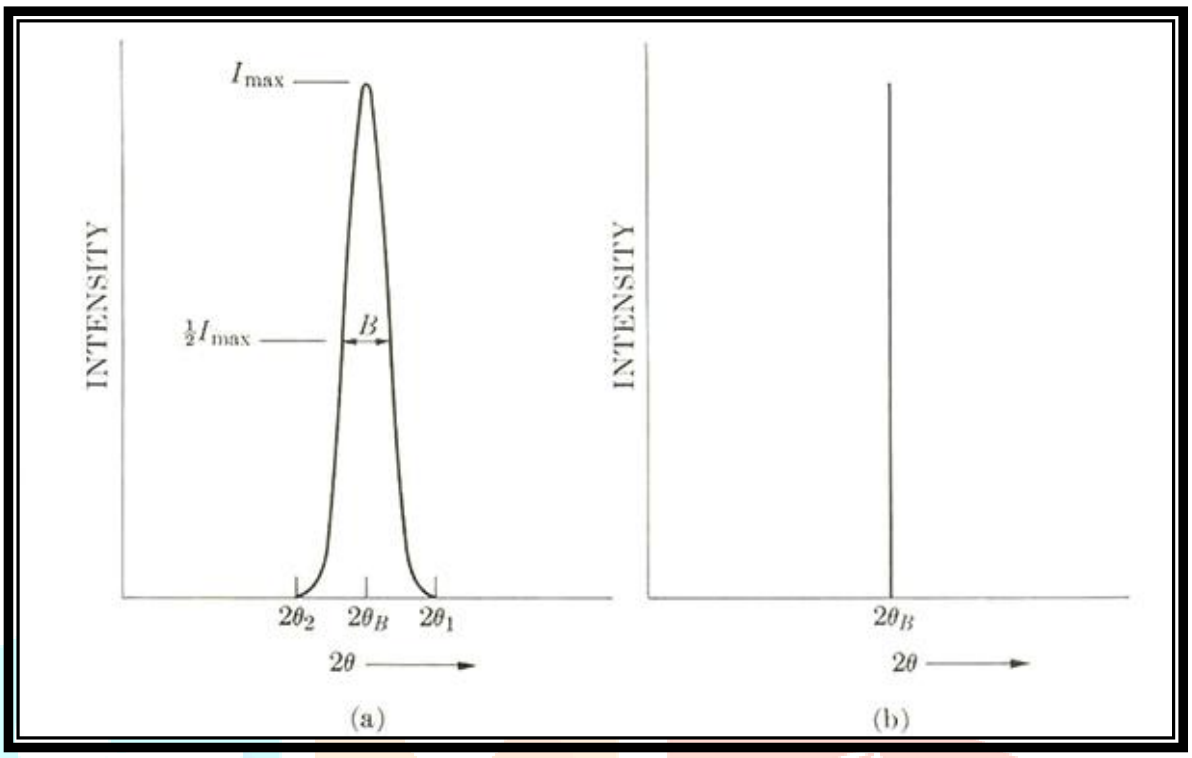


Fig 2 : Direction of Combustion technique

VI. RESULTS:

The method used for calculating various parameters involved in the Scherrer formula is shown in the figure below.



Schematic representation of the XRD graph used for calculating the particle size in general.

Scherrer's formula.

$$D = \frac{0.9\,\lambda}{\beta\,cos\theta} \longrightarrow \quad (1)$$

Where,

D = the average grain size

λ = the wavelength of $Cu_{K\alpha}$ line (1.5406Å)

β = the full-width half-maximum of the peak at θ

θ = the diffraction angle of the peak under consideration

The XRD patterns could be indexed to the $Fm\bar{3}m$ space group, face-centered cubic structure with cell parameter *a* = 5.4602 Å.

Table1:Unit Cell Parameters, Volume and Crystallite size

Sample	*a*(Å)	Crystallite size (nm)

$Ce_{(1-x)}Ni_xO_2$ (x = 0.1)	5.404	10
$Ce_{(1-x)}Ni_xO_2$ (x = 0.2)	5.452	21

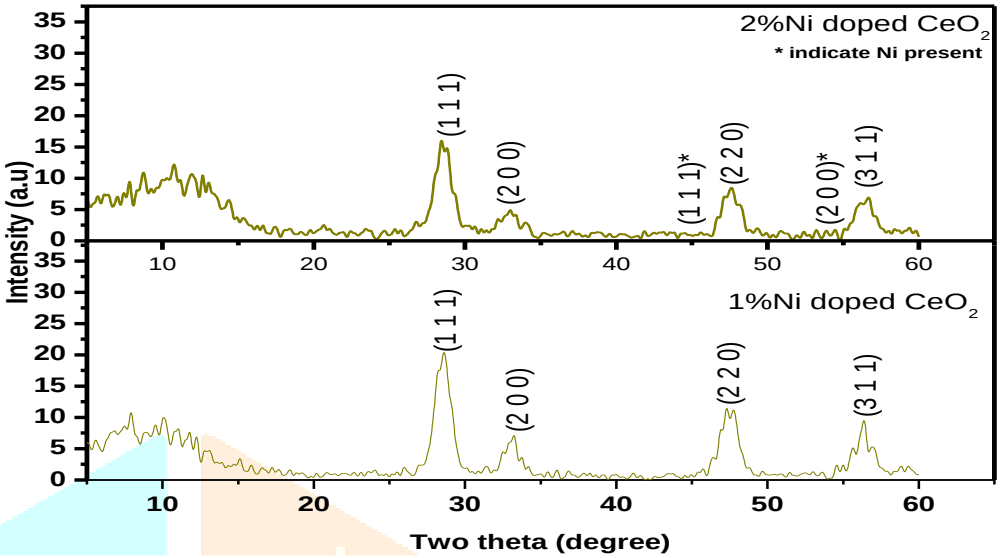


Fig. 3. Typical XRD patterns for different with Ni doping: (a) Ce $_{(1-0.1)}Ni_{0.1}O_2$ (b) Ce $_{(1-0.2)}Ni_{0.2}O_2$,

VII. CONCLUSION:

[1] Nickel Doped cerium oxide are synthesized.
[2] These were analyzed using XRD for structural confirmation.
[3] Variation in concentrations tends to have higher size of the compound.
[4] JCPDS values tends to have coincidently perfect with synthesized material.

REFERENCE:

1. Preparation and Characterization of Alumina Nanoparticles in Deionized Water Using Laser Ablation Technique

Veeradate Piriyawong,1, 2 Voranuch Thongpool,1
Piyapong Asanithi,1 and Pichet Limsuwan1, 2
1 Applied Nanotechnology Laboratory (ANT Lab), Department of Physics,
King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
2 Thailand Center of Excellence in Physics, CHE, Ministry of Education, Bangkok 10400, Thailand.

2. Nickel-Doped Ceria Nanoparticles: The Effect of Annealing on Room Temperature Ferromagnetism

Joseph C. Bear 1, Paul D. McNaughter 2,
*Paul Southern 3, Paul O'Brien 2,4 and Charles W.Dunnill 1,**

3. [3] R.Uyeda, Prog. Mater.Sci.35(1991)

4. R. W. Sigel, In processing of Metals and Alloys, Materials Science and Technology A Comprehensive Treatment, Vol. 15, ed. R. W. Cahn (VCH, Weinheim, Germany, 199, pp.358

5 .R. D. ShullandJ.M.Sanchezeds., Nanophasesand Nanocrystalline Structurs (TMS, Warrendale, PA, 1993).

6 .K.Lu., Mater. Sci. Eng. Reports; R16(1996)161.

7. R.W.Siegel, MRS Bulletin 15(1990)

8. Y.Yoshizawa, S.OgumaandK.J.Yamauchi, J.Appl.Phys.64 (1988) 6044.

9.K.Lu,in: Processingand Propertiesof Nanocrystalline Materials,eds. C.Surynarayanaetal.(TMS,Warrendale,PA,1996) p. 23.