Research review on Study of methodology for the preparation Nano crystalline Lanthanum Oxide powder

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Abstract: *In this article, we discusses about the preparation methodology properties and uses of lanthanum oxide Nano particles. Lanthanum oxide alongside concentrate on research technique of it. Lanthanum oxide Nano particles has wide application as a catalyst used in esterification, etherification, polymerization, etc. reaction. As of late, Lanthanum oxide nanoparticles have broadly characterized by using XRD, FT-IR, UV, SEM, TEM technologies. Nano Particles of the lanthanum oxide can synthesis by using precipitation, co-precipitation, Sonication probe, ultra-sonication method and this methods are broadly disused in this article.*

Keywords: Lanthanum oxide Nanoparticles, precipitation, sonication

Introduction:

Lanthanum oxide Nano Particles are fragrance-free, white, amorphous and solid in state and insoluble in water, and easily react and dissolves in weak acids. Lanthanum oxide nanoparticles have high photoelectric change proficiency. Many researcher finds the morphology of lanthanum oxide nanoparticles using SEM and TEM technology is round, and they show up as a white powder. Nanoparticles of Lanthanum oxide has many side effects such as, checked on as irritation, can influence skin, eyes, and related breathing difficulties.

Solution combustion synthesis is getting to be a standout amongst the most well known strategies for preparation of a wide assortment of materials. The fundamental preferred standpoint of utilizing this procedure is because of its straightforwardness, the expansive pertinence run, oneself decontaminating highlight because of the temperatures included, and the likelihood of acquiring products in the ideal size and shape.

Among different wet chemical processes, the combustion course observed to be straightforward and perceptive for the union of homogeneous, fine, crystalline nano powders without the intermediate decay as well as calcination steps, which other regular union courses would require. This technique is quickly rising as a standout amongst the most helpful strategies for the planning of oxide materials.[1]

Synthesis:

Lanthanum oxide solidifies as a few polymorphs. To deliver hexagonal La_2O_3, a 0.1 M solution of $LaCl_3$ showered onto a preheated substrate, normally made of metal chalcogenides. The procedure can saw as happening in two stages – hydrolysis pursued by dehydration:

$2\ LaCl_3 + 3\ H_2O \rightarrow La(OH)_3 + 3\ HCl$

$2\ La(OH)_3 \rightarrow La_2O_3 + 3\ H_2O$

An alternative route to obtain hexagonal La_2O_3 involves precipitation of nominal $La(OH)_3$ from aqueous solution using a combination of 2.5% NH_3 and the surfactant sodium dodecyl sulfate followed by heating and stirring for 24 hours at 80 °C:

$2\ LaCl_3 + 3\ H_2O + 3\ NH_3 \rightarrow La(OH)_3 + 3\ NH_4Cl$

$LaCl_3 \cdot 3H_2O \rightarrow La_2O_3$

Other routes include:

$2\ La_2S_3 + 3\ CO_2 \rightarrow 2\ La_2O_3 + 3\ CS_2$

$2\ La_2(SO_4)_3 + \text{heat} \rightarrow 2\ La_2O_3 + 6\ SO_3$

Reaction

Lanthanum oxide used as an additive to develop certain ferroelectric materials, such as La-doped $Bi_4Ti_3O_{12}$ (BLT). Lanthanum oxide used in optical materials; often the optical glasses are doped with La_2O_3 to improve the glass' refractive index, chemical durability, and mechanical strength.

$3\ B_2O_3 + La_2O_3 \rightarrow 2\ La\ (BO_2)_3$

When this 1:3 reaction blended into a glass composite, the high sub-atomic load of the lanthanum causes an expansion of the homogeneous blend of the dissolve, which prompts a lower softening point. The addition of the La_2O_3 to the glass melt leads to a higher glass transition temperature from 658 °C to 679 °C. The expansion additionally prompts a higher thickness, miniaturized scale hardness, and refractive list of the glass.[2]

Properties of Lanthanum Oxide:

Physical properties		
Properties	Metric	Imperial
Density	6.50 g/cm^3	0.235 lb/in^3
Molar mass	325.81 g/mol	-
Thermal properties		
Properties	Metric	Imperial
Melting point	2305°C	4181°F
Boiling point	4200°C	7590°F
Chemical properties		
Chemical symbol	La_2O_3	
CAS No.	1312-81-8	
Group	Lanthanum 3 Oxygen 16	
Electronic configuration	Lanthanum [Xe] $5d^1$ $6s^2$ Oxygen [He] $2s^2$ $2p^4$	
Chemical Composition		
Element	Content (%)	
Lanthanum	85.26	
Oxygen	14.72	

Table 1: The Physical, thermal and chemical properties of lanthanum oxide nanoparticles

General Application of Lanthanum Oxide:

The key applications of lanthanum oxide nanoparticles listed below:

Among them, Lanthanum oxide have vide application as solid base catalyst in many chemical reactions such as esterification, transesterification, polymerization, and etherification reactions. In this article, some of them discussed as follows.[3]

- As a magnetic nanoparticle for magnetic data storage and magnetic resonance imaging (MRI)
- In biosensors
- For phosphate removal in bio medical and water treatment (even for swimming pools and spas) applications
- In laser crystals and optics
- In nanowires, nanofibers, and in specific alloy and catalyst applications
- In piezoelectric materials to increase product piezoelectric coefficients and improve product energy conversion efficiency

- For the manufacture of high-refraction optical fibers, precision optical glasses, and other alloy materials
- In preparation of several perovskite nanostructures like lanthanum manganite and lanthanum chromite, for the cathode layer of solid oxide fuel cells (SOFC)
- For the preparation of organic chemical products catalysts, and in automobile exhaust catalysts
- To improve the burning rate of propellants
- In light-converting agricultural films
- In electrode materials and in light-emitting material (blue powder), hydrogen storage materials, and laser materials

Synthesis of glycerol carbonate from glycerol and dimethyl carbonate using magnesium–lanthanum mixed oxide catalyst: In the transesterification of DMC with glycerol, Mg– La blended oxide catalyst showed effective synergist movement as a heterogeneous base catalyst. The essential site focus on the readied Mg– La catalyst found to rely upon the development of La_2O_3, surface territory and lanthanum content on the catalyst. With expanding the measure of Mg content, development of La_2O_3 encouraged alongside the expansion of surface zone.

Notwithstanding, increment of Mg substance to a specific degree did the decline of La content on the catalyst, bringing about decline in the fundamental site fixation and reactant movement. Sort of precipitation operators and calcination temperature likewise influenced the development of La_2O_3 and surface region a molar proportion of Mg/La=3/1, KOH/K_2CO_3 as the blended accelerating specialist, and a calcination temperature somewhere in the range of 650 and 720°C were the conditions that prompted the best Mg– La blended oxide catalyst with the most noteworthy synergist action for the transesterification of DMC with glycerol.[4]

Lanthanum oxide nanoparticles immobilized reduced graphene oxide polymer brush Nano hybrid for environmental vitiation of organic dyes: Combined the La_2O_3/PTHF/rGO Nano half and halves having uniform dispersion of 20–30 nm estimated La_2O_3 nanoparticles on polymeric brushes PTHF changed GO surface. Nearness of polymer i.e. PTHF went about as the linker specialist, balancing out operator so that La_2O_3 nanoparticles can have little size for better catalysis. La_2O_3/PTHF/rGO Nano crossbreeds have been utilized as the catalyst for the debasement investigations of RhB, MO and ESY in water within the sight of $NaBH_4$, giving astounding reactant execution. All the more vitally, when contrasted with different catalysts for similar responses La_2O_3/PTHF/rGO observed to be very dynamic, with great reusability. Hence, a phenomenal reactant movement, simple recuperation and reusability make this catalyst a decent contender for the wastewater remediation.[5]

Catalytic Synthesis of Glycerol Carbonate from Biomass-based Glycerol and Dimethyl Carbonate over Li-La_2O_3 Catalysts: Li-La_2O_3 catalysts arranged by basic precipitation and impregnation strategies, and described utilizing ICP, XRD, BET, XPS, CO_2-TPD and TEM procedures. It found that the basicity of La_2O_3 was clearly changed and the association among Li and La_2O_3 happened in the wake of doping Li segment, and the reactant action of Li-La_2O_3 was very significant to the quality and substance of essential destinations on the catalysts. Li doping affected the crystal stage development of La_2O_3, and changed the uncovered precious crystal planes of the Li-La_2O_3 catalysts. The most noteworthy synergist execution got over 3.50Li-La_2O_3 catalyst calcined at 600 °C for 5 h. The glycerol transformation of 94.4% and glycerol carbonate selectivity of 92.1% got over this catalyst under the correct response states of 85°C, 3 h, and the molar proportion of glycerol and DMC being 1/3 with utilizing 0.1 g 3.50 Li-La_2O_3 catalyst.[6]

Literature review on Research Methodology for Synthesis of Lanthanum Oxide:

In this article, we examine the distinctive approaches utilizing by the scientists. The property of earth metal oxides depends on approach of synthesis. Various properties are molecule measure, morphology, immaculateness and compound structure. Wet chemical synthesis of ultrafine-fired powders keeps on being a subject of extraordinary research action as the items show a few points of interest over powder got from ordinary fired courses.

Method 1

There are relatively few reports on arrangement of La_2O_3 nanoparticles. Anyway, every one of these strategies framed La_2O_3 just at temperatures much over 100°C. The strategy for gel to crystalline transformation announced in the literature and final product was shaped at around 100 °C. This strategy varies from customary sol–gel procedure in two viewpoints; (a) no costly alkoxides reactants are vital and (b) no need of higher temperature calcination to produce final product.

Raw material: $La(NO_3)_2.6H_2O$, NaOH

Sr. No.	Research methodology	Description

1	**Process**	Lanthanum nitrate $La(NO_3)_2.6H_2O$ is dissolved in double distilled water to form 0.2 M solution. To this solution, aqueous sodium hydroxide is added dropwise to precipitate lanthanum as hydroxide. The addition of NaOH continued until pH is ~12 to ensure completion of the precipitation. The hydrated lanthanum hydroxide gel thoroughly washed free of anions and transferred to a flask fitted with a water condenser and placed in a rotomantle. It is to note that presence of anion contaminants impedes the reaction. The gel was continuously stirred for 6 h and temperature was maintained around 70–100°C. The solid mass after refluxing found to be crystalline and free flowing. Then the crystalline powder formed was filtered and oven dried
2	**Characterization**	• XRD: technique used for the crystalline structure of product sample • BET: this technique used for surface area measurements • TEM: used for the study of size of nano particles.
3	**Result**	Nano crystalline La_2O_3 powders are obtained at 100°C with the average particle size of ~30 nm by refluxing hydrated lanthanum hydroxide precipitate for 4 h.

Table 1: Research methodology 1[7]

Method 2

In this methodology, researcher utilized sol-gel technique for the synthesis of Lanthanum oxide nanoparticles.

Raw material: Commercial La_2O_3 powders, nitric acid, polyethylene glycol

Sr. No.	Research methodology	Description

1	**Process**	The starting solution was prepared by dissolving La_2O_3 in 10–20% aqueous solution of nitric acid. After the solution was filtrated, an appropriate amount of PEG added in it and dissolved completely. The mixture kept in a water bath at 90°C with continuous stirring until the solution evaporated to near dryness. When it cooled down to room temperature, a white gel formed. The gel warmed at 80°C in dry oven for 72 h, and a dry gel obtained. Then, the dry gel milled in mortar. The dry gel powder burnt out at 300°C in air to remove the organic substance and decompose lanthanum nitrate. Finally, it calcined at different temperatures and the lanthanum oxide, nano powder obtained.
2	**Characterization**	For the characterization of lanthanum oxide nanoparticles researcher used TEM and XRD techniques
3	**Result**	The weak-agglomerated nano sized powders with the mean particle size less than 40 nm obtained by controlling the process condition. The heating temperature of the dry gel powders was below 300°C, lanthanum nitrate could be decompound resulting in the liberation of brown NO_2 gas. In addition, a majority of the organic compound in the dry gel burnt off in several seconds leading to the exhalation of volumes of gas.

Table 2: Research Methodology 2[8]

Method 3

A basic and eco-accommodating concoction strategy for lanthanum oxide or lanthania (La_2O_3) nanoparticles by the arrangement ignition combination dependent on urea. The fuel urea is changed for various fuel to oxidizer proportions (F/O) or $\Psi = 0.5$ to 1.5 in the steps of 0.25.

Raw material: Urea, lanthanum nitrate, distilled water

Sr. No.	Research methodology	Description

1	**Process**	• Urea and lanthanum nitrate with different F/O ratios added to sufficient distilled water to dissolved mixed precursor crystals. • This solution in the beaker then heated on a hot plate until all the liquid evaporated. • The solution containing the above redox mixture boiled, foamed, caught fire and burned with a smoldering flame leaving a fluffy white mass at the base of the beaker. • Obtained powder contained some quantity of carbon. So to remove the carbon compound, the nano powder was annealed at 350°C for 2 h. Resulted powders were further characterized using various available methods.
2	**Characterization**	La_2O_3 nanoparticles characterized by using X-ray, BET, SEM and AFM.
3	**Result**	SEM and AFM showed that particle sizes from 70 to 125 nm.

Table 3:Research Methodology 3[1]

Method 4

Here researcher used sonication method for the synthesis of Lanthanum oxide nanoparticles. Lanthanum hydroxide nanoparticles set up by massage aqueous preparing at 110 ◦C for 24 h. The job of surfactant, calcination temperature and sonication time were researched on the morphology and particle size of the items.

Raw material: lanthanum acetate, Na_2CO_3, All the chemical are analytical grade

Sr. No.	**Research methodology**	**Description**
1	**Process**	**Materials and physical measurements** The ultrasonic generator, equipped with a converter/transducer and titanium oscillator, 12.5mm in distance across, working at 20 kHz with a most extreme power yield of 60 W, utilized for the ultrasonic light. The ultrasonic generator naturally balanced the power level.

Preparation of $La_2(CO_3)_3 \cdot xH_2O$ nanoparticles

To get ready lanthanum carbonate nanoparticles arrangement of Na2CO3, 0.8 g in 30ml (0.251M) water were added dropwise to 0.8 g arrangement of La(OAC)3 (lanthanum acetic acid derivation) (0.051M) in 50 ml water. At that point, the suspension ultrasonically illuminated in various occasions with a high-thickness ultrasonic test submerged straightforwardly in to the arrangement. The white came about items gathered by centrifugation 6000rpm, washed multiple times with refined water, and dried in broiler at 50°C.

Preparation of $La(OH)_3$ nanoparticles

In a run of the mill combination, 0.4 g of the got La2(CO3)3 nanoparticles and an answer of N2H4 (1 mmol) in 5ml of water was added to 15 ml of H2O and afterward the blend was moved into a Teflon-lined treated steel autoclave of 30 ml limit. The autoclave kept up at 110oC for 24 hr and after that permitted to cool to room temperature. In this manner, the resultant white strong item centrifuged, Washed with refined water and ethanol to expel the particles conceivably staying in the last item lastly dried at 60 °C in air.

		Preparation of La_2O_3 nanoparticles The got lanthanum carbonate nanoparticle was calcinated at 600oC for 2 hr to blend lanthanum oxide nanoparticles . Impacts of some different parameters, for example, time of sonication, calcinations temperature and surface-TGA design, comparing to arrangement of the got dried out carbonate, La2(CO3)3, the di-oxy-carbonate, La2O2CO3, and the oxide, La2O3, concur well with the determined weight misfortunes (7.4, 19.2 and 11.9 mass%, separately).
2	**Characterization**	Nano Particles of Lanthanum oxide characterized XRD, SEM, TEM, XPS, and FT-IR.
3	**Result**	La2(CO3)3·1.7H2O nanoparticles with the orthorhombic type were combined by a sono synthetic strategy. This technique presents a wide plan to combine other uncommon earth mixes with different morphologies and novel properties. Lanthanum hydroxide with normal size 20nmwere got from hydrolysis of La2(CO3)3·xH2O at 110oC for 24 hr.

Table 4: Research Methodology 4[9]

Method 5

In this work, a progression of uncommon earth oxides, for example, La_2O_3, CeO_2, Y_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3, which arranged by precipitation strategy utilizing sodium carbonate as precipitant, tried as catalysts in carbonylation of glycerol with urea under diminished weight, and lanthanum oxide found to show better reactant action for GC union. The connection between the structure or basicity of catalyst and its reactant action additionally talked about. In addition, the synergist movement basically protect amid the reusing tests researched.

Raw material: Glycerol and urea were analytical grade, $La(NO_3)_3·6H_2O$, $Ce(NO_3)_3·6H_2O$, $Y(NO_3)_3·6H_2O$, Pr_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3

Sr. No.	Research methodology	Description
1	**Process**	Lanthanum oxide prepared by precipitation MNa_2CO_3 aqueous solution was added dropwise to an aqueous solution containing 0.5 mol/L lanthanum nitrate until pH=10–11. The resulting $La(OH)_3$ precipitate was filtrated, washed with distilled water, dried, and calcined at 600°C. The obtained white powdery solid denoted as La_2O_3-600. The abbreviations represent as follows: La_2O_3-com (commercially obtained), La_2O_3-decompositon (thermal decomposition of lanthanum nitrate). Other rare earth oxides also prepared by similar precipitation method before mentioned, except for the Pr_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3 firstly dissolved in diluted nitric acid to obtain the corresponding precursors of nitrate.
2	**Characterization**	X-ray diffraction (XRD) was measured on a Siemens D/max-RB powder X-ray diffract meter. Diffraction patterns recorded with Cu Kα radiation (40 mA, 40 kV) over a 2θ range of 10° to 80°. Fourier transform infrared spectroscopy (FT-IR) transmission data were collected for pressed catalyst disk made with KBr in the range of 4000–400 cm^{-1} with a Nicolet 5700 FT-IR. The surface acid-base properties of catalysts measured by temperature programmed desorption of CO_2 carried out on TPD flow system equipped with an MS detector (DM300, AMETEK, USA). The quantitative analysis for CO_2 desorption calculated based on the integration of the corresponding TPD traces.
3	**Result**	Lanthanum oxide catalyst prepared by precipitation method and activated at 600°C found to exhibit good catalytic performance in the synthesis of GC from inexpensive urea and glycerol. The higher (turn over frequency) TOF of 1506 mmol/g.h achieved as compared to the previous reports.

Table 5: Research methodology 5[10]

Method 6

In this methodology, researcher used precipitation method for the synthesis of Lanthanum oxide nanoparticles.

Raw material: Aqueous solution of Lanthanum nitrate, ammonium acid carbonate, ammonium oxalate, ammonia, n-butyl alcohol, polyethylene glycol

Sr. No.	Research methodology	Description
1	**Process**	La(NO3)3 was disintegrated in doubly refined water. This pursued by the expansion of an alternate measure of added substances. Precipitant arrangement included drop astute for 75 min. The blend left to mix ceaselessly for 0.5h for the response to finish. The accelerate was washed with refined water a few times with doubly refined water and ethanol on the other hand, at that point were put in the stove and warmed at 80°C for 5h. Therefore, dried powders calcined at 800°C. A last superfine powder acquired.
2	**Characterization**	XRD and SEM. characterized lanthanum oxide Nano particles.
3	**Result**	The average particles size of Lanthanum oxide powders with spherical shape gained was about 188 nm.

Table 6: Research Methodology 6[11]

Method 7

In this methodology, researcher used sonication method for the synthesis of lanthanum oxide nanoparticles

Raw material: Lanthanum (III) nitrate hexa-hydrate

Sr. No.	Research methodology	Description

1	**Process**	• Lanthanum(III) nitrate hexa-hydrate (0.389 g, 0.9 mmol) was dissolved in water (20 ml) and placed in a vessel of a high-density ultrasonic probe operating at 20 kHz with a maximum power output of 600 W. Into this solution, a proper volume of LH_2 ligand (0.5 g, 1.8 mmol) in water was added dropwise. • After 1-h, a light yellow precipitate formed which isolated by centrifugation (4,000 rpm, 15 min), washed with water and acetone to remove residual impurities and dried in air. • For the preparation of lanthanum oxide nanoparticles, calcination of 1 was carried out at 800°C at a heating rate 5°C/min in air. After cooling, a white precipitate obtained. All the organic components volatilized and La_2O_3 nanostructures produced.
2	**Characterization**	The XRD pattern shows that the product is La_2O_3.
3	**Result**	The synthesis of a Nano-sized La (III) supramolecular species, 1, by the sono chemical method achieved and compared to its crystalline structure. Compound 1 decomposed at 800°C in air to produce La_2O_3 nanoparticles. La_2O_3 nanoparticles characterized by FESEM, EDAX and XRD techniques. The XRD pattern indicates that the well-crystallized lanthanum oxide nanoparticles obtained.

Table 7: Research Methodology 7[12]

Method 8

In this research work, lanthanum oxide and lanthanum oxycarbonate layers of different thicknesses were set up on titanium foils utilizing electrodeposition in natural arrangements of three fixations at high voltages. Impacts of electrodeposition focus, time, and voltage on morphology of calcined layers researched. Titanium picked as terminal since it could utilize definitely decide the proton vitality in proton-prompted responses.

Raw material: Lanthanum nitrate hexahydrate, distilled water, isobutanol,

Sr. No.	Research methodology	Description
1	**Process**	• The dried lanthanum nitrate antecedent disintegrated in isobutanol and the subsequent arrangements with groupings of lanthanum particles of 0.046, 0.092, and 2.0mg/mL, relating to 0.33, 0.66, and 14.5mM, individually, utilized in the electrodeposition. The electrodeposition done at room temperature in a cell polished titanium foils utilized as anodes and cathodes whose run of the mill thickness was 11.4 μm. • The titanium terminals washed continuously by nitric corrosive, refined water, and ethanol before gathered into the cell. The electrodeposition territory was 3.14 cm2 and the separation between the anodes was 10 mm. • The cell topped off to 3.5mL with the natural lanthanum nitrate arrangement. Voltages of the electrodeposition performed at room temperature were 200, 400, 600, and 1000V.The electrodeposition times were 30 min for 0.046 mg/mL, 30 min and 1 hr for 0.092 mg/mL, and 30 min and 8 hr for 2.0 mg/mL. • The flows observed amid the testimony time. Layers of stored lanthanum mixes washed continuously by refined water and ethanol. • After washed, they kept in ethanol for 24 hr to expel the remaining nitrate electrolyte and dried in a drying stove at 50oC. The electrodeposited layers calcined at 700K for 30min or at 900K for 60 or 200 min. • Deposition layers with thicknesses thicker than 2.0mg/cm2 arranged ordinarily by at least five testimonies where a calcination procedure performed at 700K for 30min directly after every testimony.
2	**Characterization**	Nanoparticles of Lanthanum oxide characterized by using XRD and SEM

Table 8: Research Methodology 8[13]

Method 9

Lanthanum Oxide nanoparticles arranged by a basic reflux strategy. The impact of forerunner focus, the impact of response temperature and the impact of calcination explored and announced.

Raw material: La $(NO_3)_2$ $6H_2O$, NaOH, & Urea

Sr. No.	Research methodology	Description
1	**Process**	La $(NO_3)_2$ $6H_2O$, NaOH, & Urea is dissolved in double distilled water to form the solution. The solution stirred by a magnetic stirrer for about 45 min. The homogeneous solution obtained transferred to a round bottom flask, which maintained at desired constant different temperature and for different hours. The round bottom flask allowed to cool down in naturally and to reach the room temperature. The final product collected from the round bottom flask and washed several times with double distilled water. The product dried at 100°C for 2 hours and the final product was calcinated for 500°C. The final product is Lanthanum Oxide nanoparticles.
2	**Characterization & Result**	**SEM:** The approximate band gap of the as-prepared and calcinated samples as calculated from the absorption spectrum are 5.7 and 5.8 nm respectively **FT-IR:** results show the presence of La_2O_3 is evident from the stretching vibration peaks at 556cm^{-1} and 570cm^{-1}. The broad peaks around 500-1000 cm^{-1} correspond to the metal-oxide vibrations. A sharp peak observed at about 462 and 571 Cm^{-1}, which can attributed to stretching vibration of the La–O bond.

		UV: The optical absorbance spectrum of La_2O_3 nanoparticles for the wavelength length range (200-1100 nm) recorded using UV-visible spectrophotometer.

Table 9: Research Methodology 9 [14]

Method 10: In This Research paper manages the starter thinks about on blend and portrayal of lanthanum oxide (La_2O_3) nanoparticles pursue Pechini strategy yet utilizing distinctive reactants.

Raw material: Glutaric acid and Propylene glycol

Sr. No.	Research methodology	Description
1	**Process**	In this method initially, mixing of the Lanthanum Nitrate with a Chelating agent, a mix 1:1 and 1:30 of Glutaric acid and used Propylene Glycol as Fuel. All reactant mix well and put it solution in muffle furnace at 600-800 ^oC for 4-5 hrs. After that reaction, we get solid particles. It cool at room temperature and give sample for various analysis. All reagents used mixed in Double Distilled water. The experiment was carried out with two Fuel to Oxidizer ratios i.e., Ψ=1 and Ψ=1.30. $4\ La(NO_3)_3 + 2\ C_5H_8O_4 + 2\ C_3H_8O_2 \rightarrow 2\ La_2O_3(s) + 16$
2	**Characterization**	Structural properties examined by SEM reveals porous and fuzzy network of Nano crystallineLa_2O_3.
3	**Result**	La_2O_3 Nano powders have been successfully synthesized via Pechini method using different F/O ratios i.e., Ψ=1 and Ψ=1.30. The average crystallite sizes of samples synthesized by Pechini method are 18-28 nm for Ψ = 1 and 36-46 nm for Ψ= 1.30 and those are in good agreement with PSA results. From the above characterizations, we inferred that the sample obtained from higher F/O ratio was phase pure and crystalline in nature.

Table 10: Research Methodology 10 [15]

Conclusion

Utilizing substance techniques, e.g. co-precipitation, sol–gel, aqueous, ultra-sonication, Sonication probe and colloid emulsion system have affirmed proficiently control the morphology and substance arrangement of arranged powder. The primary favorable circumstances of these techniques are the expanded homogeneity and high surface region of the subsequent powders, which lead to generally high reactivity and thus low sintering temperatures.

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