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Synthesis and Characterization of Titanium Oxide and Aluminium Oxide Nanoparticles

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Abstract -The point of the task is to examine and break down the basic properties of Nano-sized Titanium di-oxide and Aluminium oxide which are set up by utilizing sol-gel technique. The sol-gel strategy is a wet substance procedure which has a power over the surface and surface properties of the materials and serves to be the least complex technique for delivering nanoparticles. The portrayal of these nanoparticles was acted in FESEM that empower the high goals imaging of single nanoparticles with sizes well underneath 10 nm. Their concoction creation is resolved in EDX spectroscopy to dissect the vitality range of the bounty of explicit components.

***Key Words*:**Nanoparticles, Titanium dioxide (TiO2), Aluminium oxide(Al2O3), Sol-gel method, Energy Dispersive Spectroscopy, Scanning Electron Microscope.

1.INTRODUCTION

Nanotechnology is a moderately new part of science that has discovered a wide scope of uses that run from vitality creation to modern creation procedures to biomedical applications. As of late, the utilization of nanotechnology has picked up consideration in different applications. Nanotechnology alludes to innovation that is actualized at the nano-scale in reality.Nanoparticles are strong colloidal particles going from 1-100nm in size and is rising quickly because of their surface volume proportion.

Titanium dioxide (TiO2) has become some portion of our regular day to day existences. It is found in different customer merchandise and results of every day utilize, for example, beauty care products, paints, colors and varnishes, materials, paper and plastics, nourishment. Titanium dioxide (TiO2) is an extremely helpful semiconducting change metal oxide material and displays one of a kind qualities, for example, minimal effort, simple taking care of, non-poisonousness and protection from photochemical and concoction disintegration. These focal points make TiO2 a material in sunlight based cells, concoction sensors, for hydrogen gas development, self-cleaning surfaces and natural decontamination applications.

Al2O3 nanoparticles can be combined by numerous methods including ball processing, sol-gel, pyrolysis, faltering, aqueous, and laser removal. The sol–gel process is a wet concoction procedure utilized for the manufacture of both smooth and fired materials. Sol-gel is one of the best procedures to manufacture high photograph synergist titanium dioxide nanostructures with controlled shape and porosity.. The sol-gel process is additionally a concoction procedure applied to create metal framework composites.

2.EXPERIMENTAL PROCEDURE

Many methods are used for the synthesizing the nanoparticles but sol-gel method is the simple technique also it gives maximum rate of purity.

2.1Preparation of Titanium Oxide Nanoparticles

The TiO2 Nanoparticles are prepared using the following reagents mentioned in the table 2.1.

S.NO	COMPOUNDS	AMOUNT
1	Titanium Isopropoxide ($C_{12}H_{28}O_4Ti$)	50mL
2	Urea (CH_4N_2O)	1g
3	Hydrochloric acid (HCl)	200mL

Table -1

Method

Bi-distilled water and urea are introduced into a beaker and the solution is stirred for 5 minutes. Titanium isopropoxide was added drop-wise and the obtained suspension was stirred for 30 minutes using a magnetic stirrer for obtaining a homogenous solution. A clear milky white solution is obtained. This suspension is then introduced to a water bath for one hour at 90℃.The suspension becomes gel like solution. The separated product was dried at 80℃ in a furnace for 12 hours to remove the water content. The obtained TiO2 is in the form of powder which is then grinded to fine particles of Nano-size.

2.2Preparation of Al_2O_3 Nanoparticles

Al_2O_3 nanoparticles were prepared by using aluminium foil so that it will be cost-effective and easier for the preparation of these nanoparticles.

S.NO	COMPOUNDS	AMOUNT
1	Aluminium Foil	5.29gms
2	Sodium Carbonate (Na_2O_3)	35gm
3	Hydrochloric acid (HCl)	36.6ml

Table 2.2

Method

Aluminium foil is washed with ethanol and added to HCl for dissolving. The foil is reacted with HCl and forms a black colour solution that consists of impurities from the foil. The solution is filtered using air filters which removes all the impurities and leave in a clear solution of aluminium chloride ($AlCl_3$). Sodium carbonate (Na_2CO_3) is added to the $AlCl_3$ solution to form Aluminium oxide. This solution is washed several times with distilled water to form sol-gel solution. The Aluminium oxide solution is kept still under room temperature until it gets settled down at the bottom. This phenomena occurs due to the reason that sodium chloride is soluble in water and gets dissolved with the solution and gets evaporated and the Aluminium oxide (Al_2O_3) which is not soluble in water settled down in sol-gel form. Then the obtained Al_2O_3 is dried in oven at 100℃ for few hours and grinded to fine powder.

3.CHARACTERIZATION

In order to visualize the morphology of the nanoparticles arranged, the dry examples were broke down utilizing field emanation examining electron spectroscope (FE-SEM) to assess high goals pictures of single nanoparticles of size underneath 10nm.

FESEM Analysis OF TiO_2 AND Al_2O_3 Nanoparticles

The microstructure analysis of TiO_2 Nanoparticles is analysed using below FE-SEM image Fig 3.1 depicting the distribution of the nanoparticles examined at the magnification range of 500 X with the voltage measured as 10.00kV

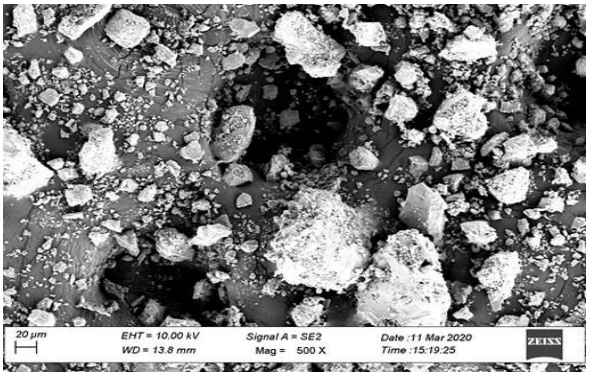

Fig-3.1FESEM Macrostructure Image of TiO2 Nanoparticles

Fig 3.2 depicting the distribution of the nanoparticles examined at the magnification range of 50.00K X with the voltage measured as 10.00 kV that shows the macrostructure of the nanoparticles.

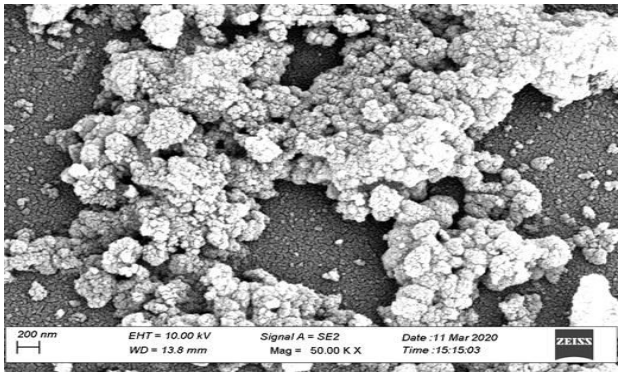

Fig-3.2 FESEM Microstructure image of TiO_2 Nanoparticles

Figure 3.3 depict the distribution of the nanoparticles examined at the magnification range of 50.00KX with the voltage measured as 5.00 kV that shows the macrostructure of the nanoparticles.

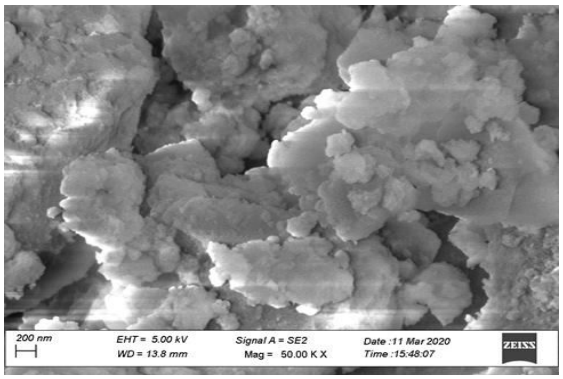

Fig-3.3 : FESEM Microstructure Image of Al_2O_3 Nanoparticles

Figure 3.4 depict the distribution of the nanoparticles examined at the magnification range of 50.00KX with the voltage measured as 5.00 kV that shows the macrostructure of the nanoparticles.

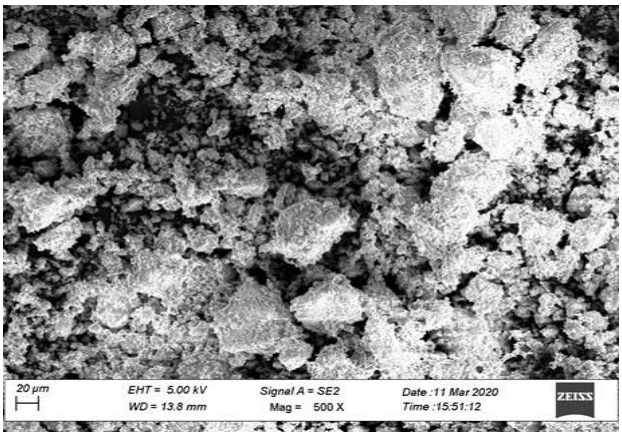

Fig-3.4 : FESEM Macrostructure Image of Al_2O_3 Nanoparticles

Energy Dispersive X-Ray Microanalysis

Energy dispersive X-ray microanalysis is an analytical technique used for the elementalanalysis or chemical characterization of a sample. It allows to identify the composition of nanoparticles.

In figure 3.4, the graph is drawn by taking x axis as counts per second (cps/ev) and y axis as electrovolt.by this analysis it is observed as the presence of titanium oxide nanoparticles is 67.5 percent which were prepared by using sol gel solution.

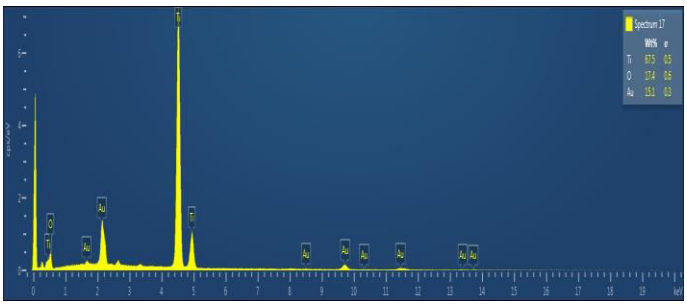

Fig-3.4 : EDX image showing the presence of TiO_2 Nanoparticles

In figure 3.5, the graph is drawn by taking x axis as counts per second (cps/ev) and y axis as electrovolt. By this analysis it is observed as the presence of aluminium oxide nanoparticles is about 50.9 percent which is prepared using sol- gel method.

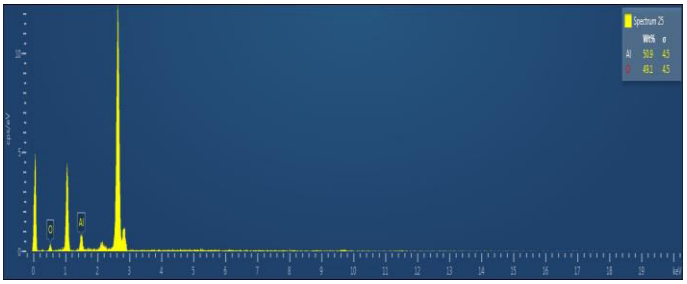

Fig-3.5: EDX image showing the presence of Al_2O_3 Nanoparticles

4. CONCLUSION

Titanium dioxide and aluminium oxide nanoparticles have been effectively blended utilizing a sol-gel concoction procedure. By contrasting the different strategies for delivering the nanoparticles the sol-gel strategy serves to be the best in view of its lower handling temperatures and elevated level of immaculateness. Since the expense of the nanoparticles is high and the virtue can't be recognized, it is fitting that these strategies can be utilized for setting up the nanoparticles which is financially savvy and requires negligible hardware. The characterizations of the examples were performed utilizing FE-SEM that shows the size of each Nano-sized particles and their morphology is examined. The measure of compound structure of the particles is resolved utilizing EDX spectroscopy.

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