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Experimental Investigation for the Preparation of Taro Leaf Nanoparticles by Sol-Gel Method and its Characterization

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Abstract: In the present work, nano particles of Taro leaf were successfully synthesized chemically by modified Sol-gel method. Methanol is used as a solvent and buffers are added to take care for the homogeneity and PH value of the solution. Compared to micro particles, Nanoparticles have advanced characteristics and distinctly different properties. Taro leaf nanoparticles are one of the leaves nanoparticles which has varied and different properties when compared to other. Taro Leaf nanoparticles have considerable attention due to their attractive physical and chemical properties, Silver nitrate is taken as the metal precursor and sodium borohydride as a reducing agent. This preparation is simple, but the great care must be exercised to make stable particles. Here the Taro leaf nanoparticles are synthesized by sol gel process. Therefore the nanoparticles are characterized by the different techniques like SEM to find the size morphology and composition of leaf nanoparticles, XRD to know the lattice parameters. The peaks in the XRD pattern are in good agreement with the standard values.
Keywords: Taro leaf, Methanol SEM, EDS, XRD

I. INTRODUCTION

Some natural surfaces, including the leaves of water-repellent plants such as Taro, are known to be super hydrophobic and self-cleaning due to hierarchical roughness (micro bumps superimposed with nanostructure) and the presence of a wax coating . Roughness-induced super hydrophobic and self-cleaning surfaces are of interest in various applications, including self -cleaning windows, windshields, exterior paints for buildings and navigation ships, utensils, roof tiles, textiles, and applications requiring a reduction of drag in fluid flow, e.g., in micro/ nano fluidics. Super hydrophobic surfaces can also be used for energy conversion and conservation. Non wetting surfaces also reduce friction at contacting interfaces in machinery.

II. LITERATURE WORK

Research on nanoparticle is currently an area of intense scientific research, due to as wide variety of potential applications in the optical, electronics and biomedical. The word “Nano” is a greek word whose dwarf meaning is extremely small. Nanoparticles are of great scientific interest as they are effectively a bridge between bulk materials and atomic or molecular structures. The materials properties will change as their size approaches to nanoscale. Nanomaterials are often show a unique and considerable changes in physical, chemical and biological properties compared to macro scaled counter parts [1].

In Bulk materials larger than one micrometer the percentage of atoms at the surface are minuscule relative to the total number of atoms of the material. Example, the bending of bulk copper (wire) occurs with movement of copper atoms/clusters at about 50nm scale. Copper nanoparticles which are smaller than 50nm are considered as super hard materials that does not exhibit the same ductility and malleability as bulk copper. The Ferroelectric materials smaller than 10nm can switch their magnetization direction using thermal energy at room temperature, therefore temperature making them unused for memory storage. The interaction of the particle surface with the solvent is strong enough to overcome differences in density because suspensions of nanoparticles, which usually result in a material either floating or sinking in a liquid. Unexpected visible properties are often have in nanoparticles because they are small enough to confine their electrons and produce quantum effects. Example, gold nanoparticles appear deep red to black in solution. Nanoparticles have a very high surface area to volume ratio and this provides a tremendous driving force for diffusion, especially at elevated temperatures. The high surface area to volume ratio also reduces the melting temperature of nanoparticles. Generally, metal nanoparticles can be prepared and stabilized by physical and chemical methods; the chemical approach, such as chemical reduction, photochemical reduction and electrochemical techniques are most widely used [2, 3]. For the synthesis of nanoparticles number of approaches are available such as reduction of metal salt in aqueous phase [4], micro emulsion approach [5], sol-gel technique [6], hydrothermal technique [7], green approach [8] etc. Studies have shown that the morphology, size, stability, physical and chemical properties of the metal nanoparticles are strongly influenced by the experimental conditions.

III. EXPERIMENTAL DETAILS

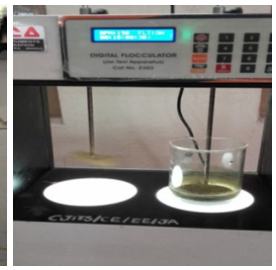
Material Used:

- Taro Leaf Powder
- Methanol

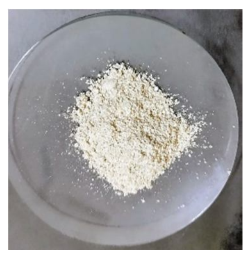
The sol-gel method is a versatile process used for synthesizing various oxide materials. The source used in this research was Taro leaf powder which is dried for 10days & Methanol is used as a solvent. The solution was prepared by mixing 1gm of Taro leaf, 60 ml Methanol, The solution was let to stirred for 10hrs at room temperature with 150rpm. The whole solution is if filtered with filter paper. After filtering, the so formed gel is dried at 60 ºc for 24 hr in an oven.

Taro leaf Powder


Methanol


Stirrer

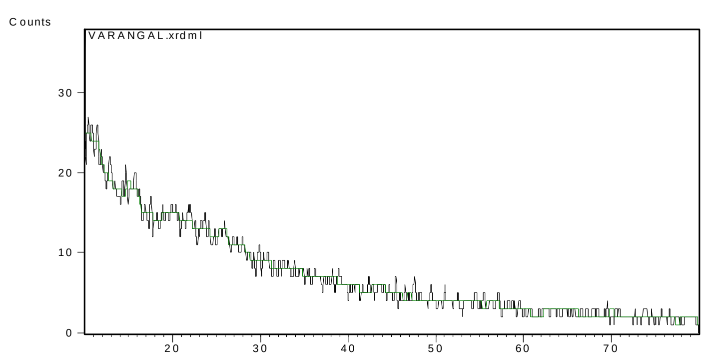

Filtering


Nano particles

The samples were characterized by Scanning Electron Microscope (SEM), Electron dispersive spectroscopy (EDS), X-ray diffraction (XRD). X-ray diffraction (XRD) technique was used to identify composition of the Taro leaf nano particles which were synthesized by sol-gel method.

IV. RESULTS & DISCUSSIONS

1) X-RAY DIFFRACTION:



XRD pattern of Taro leaf nano particles.

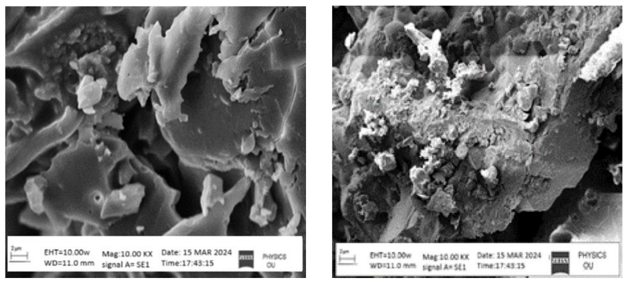
According to the Debye-Scherer's equation:

$$D = \frac{0.9\lambda}{\beta\cos\theta}\text{nm}$$

Where D – Average size of the particle [nm]
λ --Wavelength of the radiation [A°]
θ –Diffraction angle [degree]
Β – Full width half maximum (FWHM) of the peak [radians]
From the above formula obtained average crystalline size is 20nm. .

2) *SCANNING ELECTRON MICROSCOPY:*

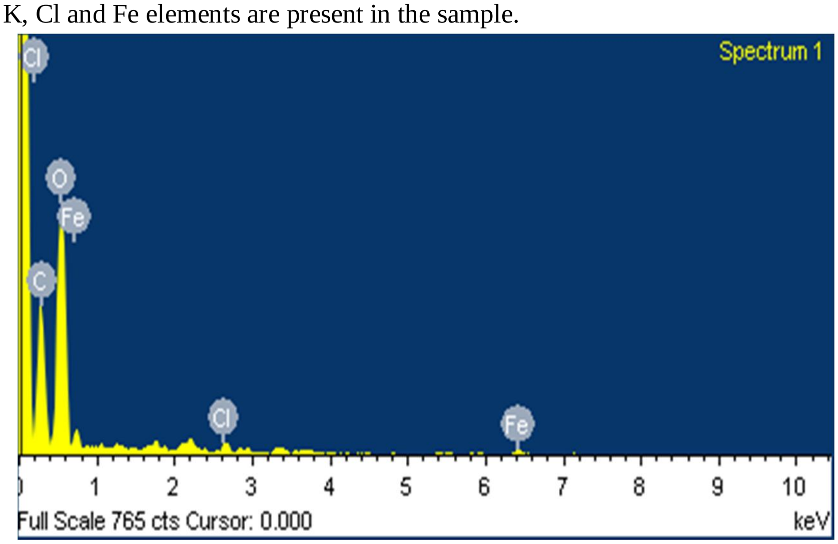
SEM images of Taro Leaf nano particles, the grain size, shape and surface properties like morphology were observed by using SEM with different magnifications. The SEM images of Taro Leaf nano particles shows respectable morphology and grain size of Taro leaf nano particles were nearly 20 nm.



SEM image of Taro leaf nano particles

3) *EDX OF Taro LEAF NANO PARTICLES:*

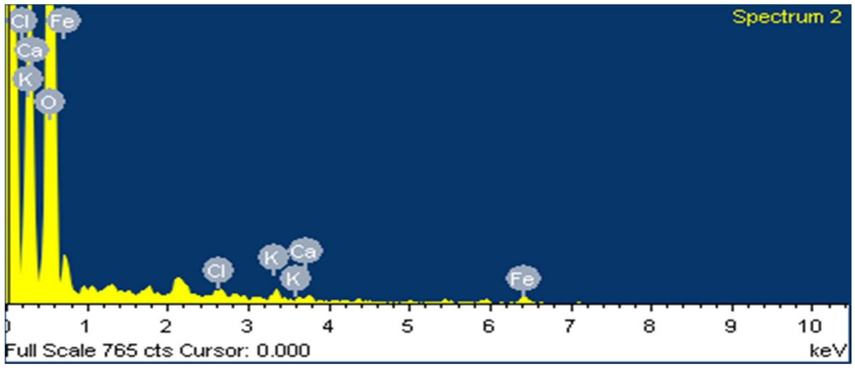
The EDX of the sample was done by the SEM machine. The Energy dispersive X-ray spectroscopy reveals that the required phase has present. $CaCO_3$, SiO_2, K, Cl and Fe elements are present in the sample.



EDX image of Taro leaf nano particle

Element	Weight %	Atomic %
C K	20.92	31.35
O K	53.18	59.82
Cl K	2.61	1.33
Fe L	23.28	7.50
Totals	100.00	

Table 1: Composition of Taro Leaf nano particles



EDX image of Taro leaf nano particle

Element	Weight %	Atomic %
O K	60.58	83.46
Cl K	1.56	0.97
K K	2.30	1.30
Ca K	1.55	0.85
Fe L	34.01	13.42
Totals	100.00	

Table 2: Composition of Taro Leaf nano particles

V. CONCLUSIONS

The Taro Leaf nano particles were successfully synthesized by Sol-gel method. The samples were characterized by Scanning Electron Microscope (Sem), Electron dispersive spectroscopy (EDS), X-ray diffraction (XRD). X-ray diffraction (XRD) technique was used to identify composition of the Taro leaf. The composition is identified by wt%. From the composition it is observed that 60% Taro leaf nano particles contains Silicon dioxide (SiO_2) ie., 60.58%. The diameter of sphere-like as-prepared nano particles was about 20 nm as estimated by XRD technique

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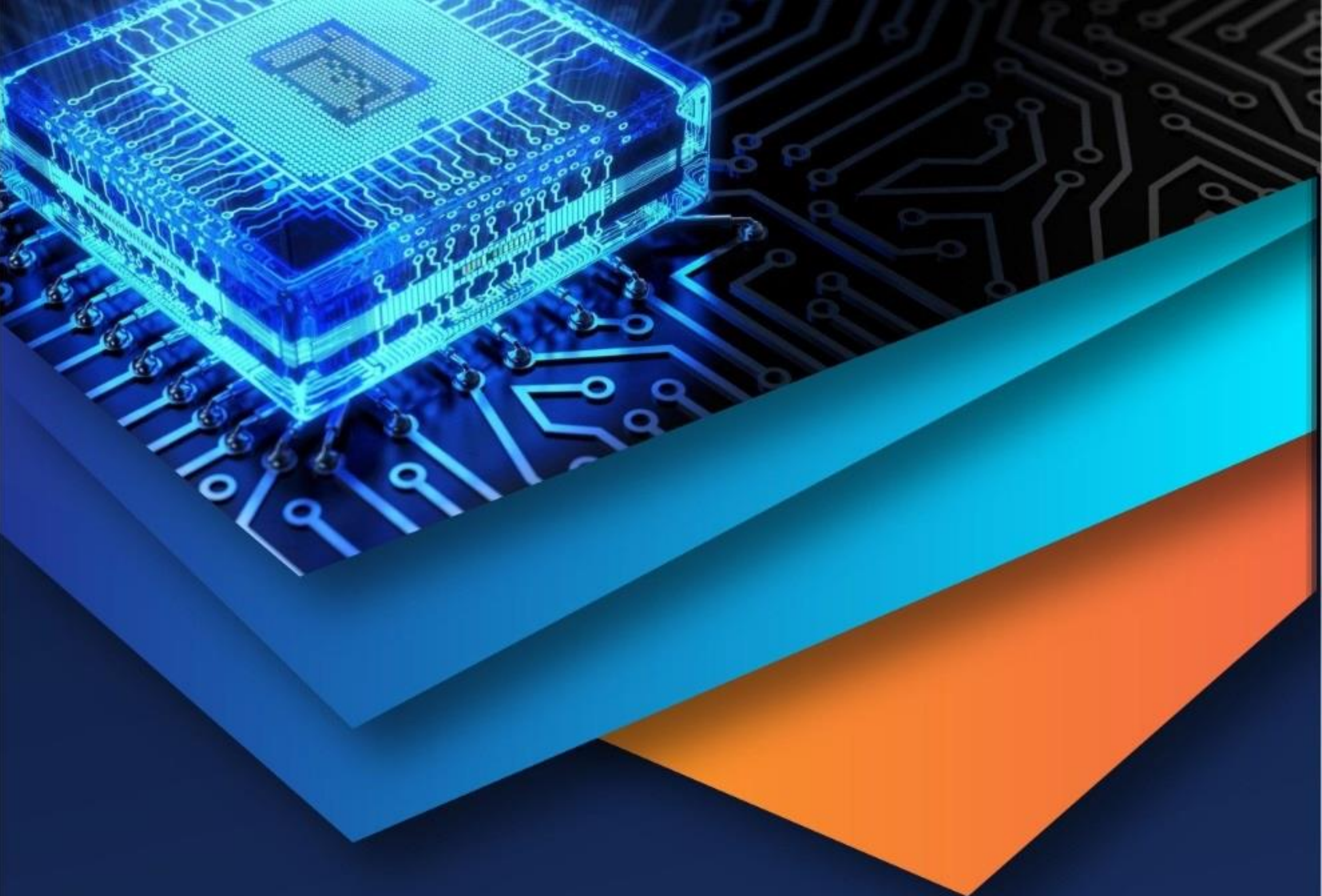

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