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GREEN AND CHEMICAL SYNTHESIS OF ZINC OXIDE NANOPARTICLES BY CO-PRECIPITATION METHOD

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Abstract
Rapidly expanding research in nanotechnology has led to exciting progress in versatile tool of medical and biological applications. Nanomaterials play a very important role in today's material world. Nanoparticles are extensively studied for their optical, electronic, catalytic properties. In this present study, ZnO nanoparticles were synthesized using co-precipitation method through eco-friendly green and chemical method. The effect of green and chemical synthesized ZnO nanoparticles structural and optical properties were analyzed. The ZnO nanoparticles were synthesized by Zinc sulphate, Sodium hydroxide and Potato extract. In this synthesis starch rich potato and Sodium hydroxide acted as reducing agent and stabilizing agent on freshely formed ZnO nanoparticles. The synthesized nanoparticles were characterized by scanning electron microscope, UV-Visible spectroscopy, FT-IR spectroscopy.

Key Words: Zno, Green Method, Chemical Method, Solanum Tuberosum, Sodium Hydroxide.

Introduction

ZnO is a wide band gap semiconductor having high optical transparency and Luminescence in visible and near ultraviolet range of spectrum. Therefore, it is usually used in light emitting diodes and solar cells. It is ease to synthesize Green and chemical ZnO nanoparticles have low toxicity, biodegradability, large surface area, inexpensive due to these properties which have following biomedical applications. Bio imaging (penetration of ZnO nps in human skin was imaged Drug delivery Biosensing [1, 7-10]. Physical methods of synthesis are costly and require extensive labour and time. The green synthetic method employing plant extracts have drawn attention as a simple and viable alternative to chemical and physical methods. This biological approach appears to be a cost effective alternative to Conventional physical and chemical methods of synthesis [1-10]. In a chemical method ZnO is synthesized by using sodium hydroxide acting as a reducing and stabilizing agent.

The potato is tuberous crop which is best known for its carbohydrate contents. The predominant form of this carbohydrate is starch. Starch is a natural polymer that is abundant, renewable, inexpensive and widely available. Starch can be obtained by hydrolysis of starch rich materials. Boiling the fresh vegetables gives large amount of starch and glucose by hydrolysis. It consists of two types of biopolymers amylase and amylopectin which act as a reducing as well as capping agent [3].

2 Experimental

2.1 Materials

Zinc sulphate ($ZnSO_4.7H_2O$) as the metal precursor, Fresh potatoes purchased from local market act as the reducing and capping agent, Ammonia (NH_3), Sodium hydroxide were of analytical grade and purchased from Merck. Double distilled water is used for rinsing and makeup of all aqueous solutions.

2.2 Synthesis of Zinc Oxide nanoparticles by green Method

The potato is tuberous crop which is best known for its carbohydrate contents. The predominant form of this carbohydrate is starch. Starch is a natural polymer that is abundant, renewable, inexpensive and widely available. Starch can be obtained by hydrolysis of starch rich materials. Boiling the fresh vegetables gives large amount of starch and glucose by hydrolysis. It consists of two types of biopolymers amylase and amylopectin which act as a reducing as well as capping agent.

2.3 Preparation of potato extract

For the synthesis of ZnO nanoparticles, we used potato extract as the unique reducing and stabilizing agent. The potatoes washed several times with water to remove the dust particles and then sun dried to remove the residual moisture. Then 13g fresh raw potatoes were peeled off and cut into smaller pieces. Then the chopped potatoes were placed in 500 ml glass beaker along with 300 ml of double distilled water. The mixture was then boiled to 85^0 C for 30 minutes until the colour of the solutions changes to milky. After cooling to room temperature the solution was filtered through Whatman filter paper. Thus, the obtained potato extract was stored in a refrigerator and used within a week.

2.4 Preparation of zinc Oxide nanoparticles

In the present work, green synthesis zinc oxide nanoparticles (ZnO NPs) were prepared by according to the method offered by F.Buazar et al. (2015) [3]. For the synthesis of ZnO Nps 50 ml of potato extract liquid solution was taken and boiled to 80^oC

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using stirrer heater. 3g of zinc sulphate solution was added to the potato extract solution as the temperature reached 85^{0}C. Heating treatment was required to expand the starch molecules, which in return accelerates the reduction process by resulted electron-donar groups. The PH of the mixture solution was then adjusted to 7 by gradual addition of ammonia and milk like solution was formed. The solution was stirred for an additional 25 min at 85^{0}C and the resulting precipitate was washed with acetone and DI water and dried at 100^{0}C in air heated furnace at half an hour. At the end ZnO nanopowder was formed. The prepared ZnO nanopowde were stored at room temperature.

2.5 Synthesis of Zinc Oxide nanoparticles by Chemical Method

The zinc oxide nanoparticles were prepared by wet chemical method as discussed by kumar et al (2013). In chemical method, instead of bio extract, Sodium hydroxide (NaOH) was added to the precursor solution. To the aqueous solution of zinc sulphate, sodium hydroxide solution was added slowly drop wise in a molar ratio 1:2 under vigorous stirring. The precipitation was occurred 1hr after mixing the solutions which was washed with acetone and double distilled water. The precipitate was dried in an oven at 100^{0}C, afterwards ZnO nanopowder was obtained.

3 Results and Discussion

3.1 Characterization of ZnO nanoparticles

The synthesized nanoparticles characterized through the instrumental analysis such as Scanning Electron Microscope (SEM), UV –Visible spectrometer, and FTIR (Fourier Transform Infra-red Spectroscopy). The optical properties of ZnO nanoparticles are analyzed by UV –Visible spectra. The functional groups in the Zinc Oxide nanoparticles were analyzed by FTIR (Fourier Transform Infra-red Spectroscopy) and Scanning Electron Microscope (SEM) was used to study the morphology and size of the nanoparticles which are follows with their scanning images.

3.2 Morphology analysis of ZnO nanoparticles

A typical SEM image of green and chemical synthesized ZnO Nps formed is displayed in figure 1 and 2 observed at different magnifications. High resolution SEM images show the presence of nanoparticles. The SEM images represent the agglomeration of particles and also narrow particle size distribution. The average sizes of selected individual particles are in the order of 100-200 nm. Similarly, the particles are hexagonal in shape in green and chemical synthesized ZnO nanoparticles.

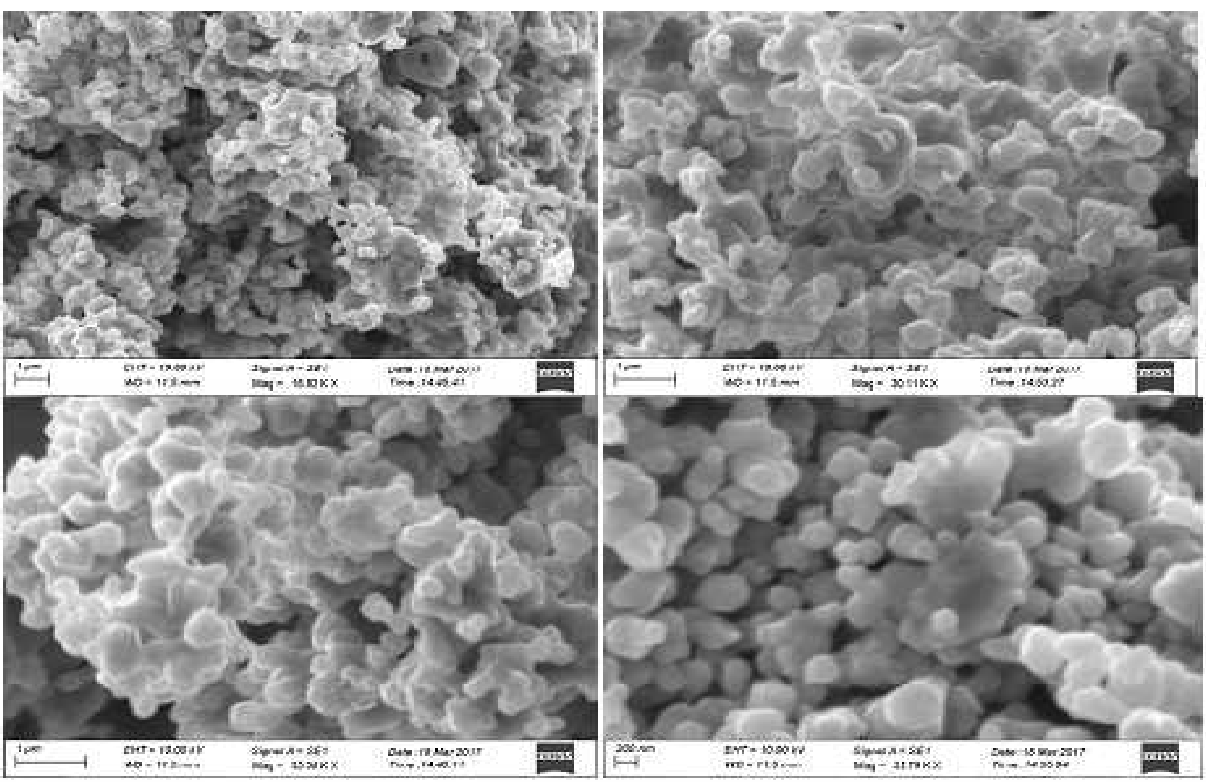

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Fig 1. SEM image of green synthesised Zno nanoparticles at different magnifications

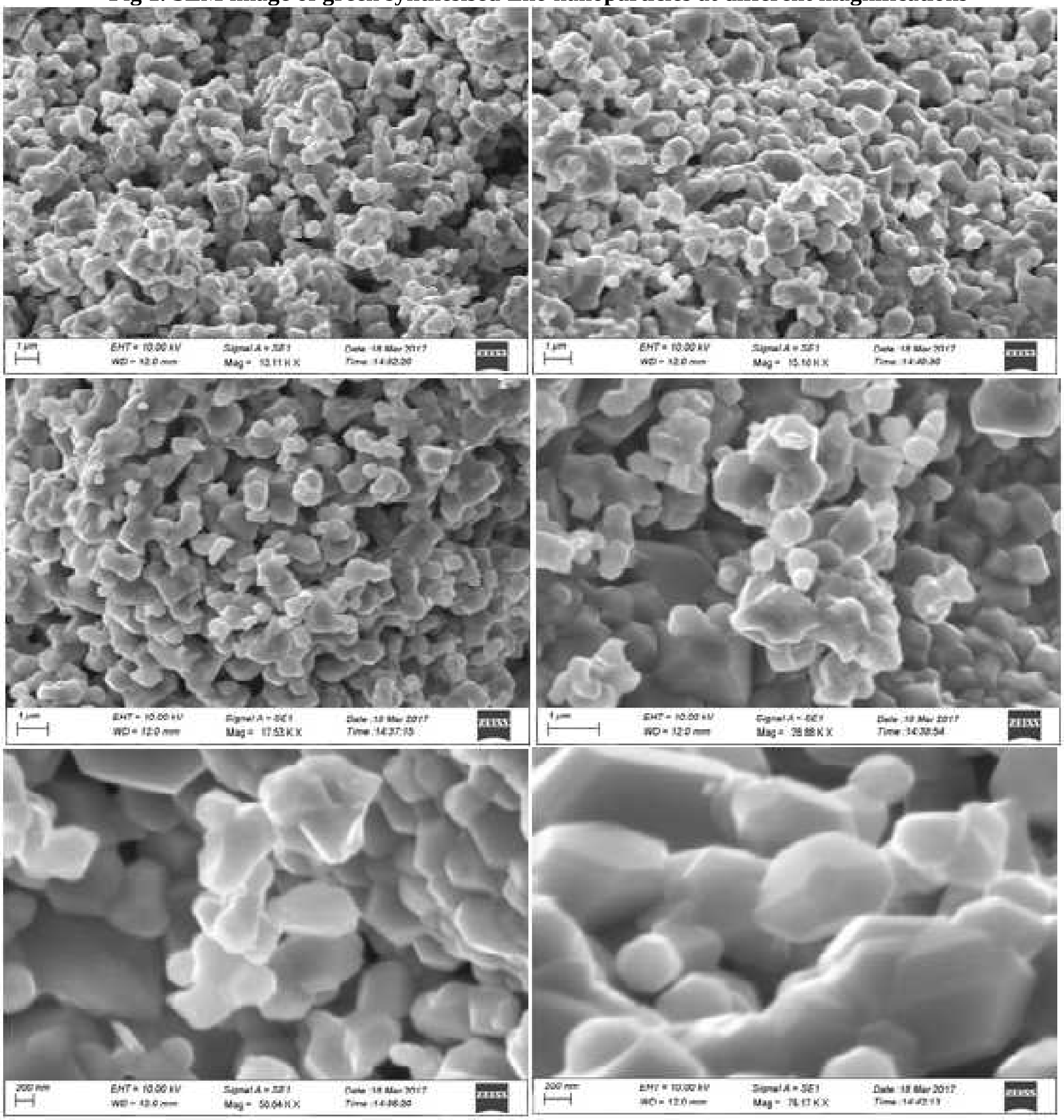

Fig 2. Sem Image Of Chemically Synthesized Zno Nanoparticles At Different Magnification

3.3. FTIR analysis of ZnO nanoparticles

The FTIR spectroscopy is performed in order to quickly establish the presence and absence of the various vibrational modes present in synthesized particles. The figure 3 and 4 shows the FTIR spectrum of the ZnO particles synthesized from chemical and green method acquired in the range 500-4000 cm^{-1}. Various modes of vibration are observed different regions of FTIR spectrum. The peaks at 400 and 600 cm^{-1} observed in the spectrum indicate the presence of –OH and C=O residues which may be due to precursors used in reactions. IR spectra of synthesized ZnO show a high intensity band around 446 cm^{-1} due to the stretching mode of zinc and oxygen bond.

The peak near 3481cm^{-1} indicates alcohols (O-H stretch) 1590 cm^{-1} peak explore the amines(N-H bend), the peak exit at 1408 cm^{-1} (O-H bend), the band near 1119 cm^{-1} ketons (C-C stretch), The following peaks represents 784 cm^{-1} alkyl halides (C-Cl stretch) aromatic C-H bend.

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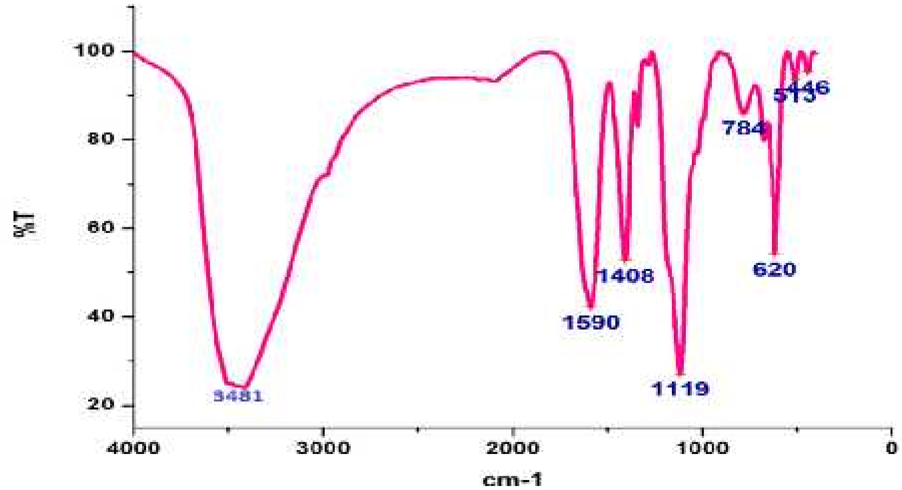

Fig 3. FTIR Spectra of Green Synthesized Nanoparticles

The spectrum of interference pattern obtained in the FTIR images clearly shows that the characteristic absorption peaks of ZnO nearer to 390 cm^{-1} and also authenticates presence of ZnO.

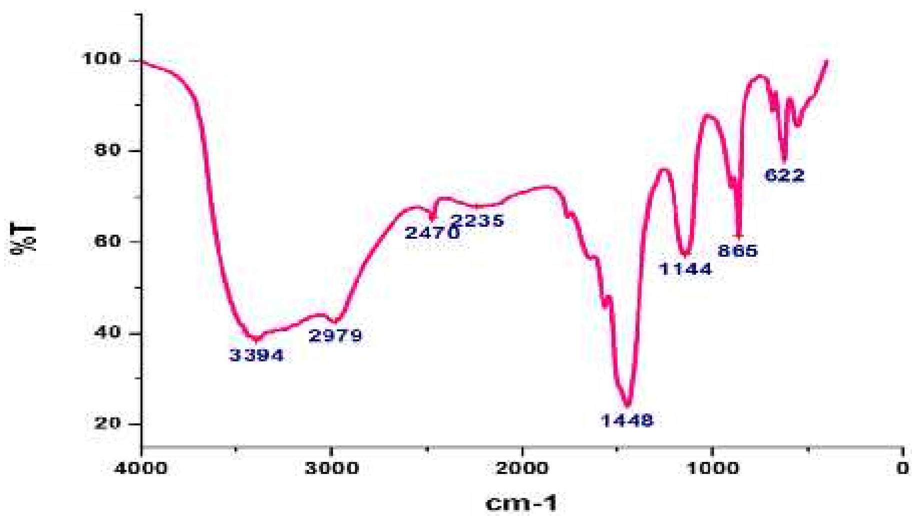

Fig 4. FTIR Spectra of Chemical Synthesized Nanoparticles

The peak near to 3394 cm^{-1} corresponds to amines (N-H stretch), the peak at 2979 cm^{-1} indicates O-H and alkanes (C-H stretch), the peak appears at 2235 cm^{-1} (C=N stretch), the following peaks produces at 865 cm^{-1},622 cm^{-1} due to aromatics (C-H bending).

3.4 UV-V Is Analysis of ZnO Nanoparticles

UV-Visible absorption spectroscopy is widely being used techniques to examine the optical properties of nanosized particles. UV-Vis absorption spectrum of zinc oxide nanoparticles synthesized by chemical and green method is shown in figure 5 and 6. UV-Vis absorption spectra reveals that the synthesized ZnO nanoparticles from chemical and green method are monodispered particles shows a absorption peaks at 333 nm and 370 nm which indicates the formation of ZnO nanoparticles. Incident light creates oscillations in conduction electrons on the surface of the nanoparticles and electromagnetic radiation is absorbed. The maximum wavelength of the absorption peak indicates the particle size.

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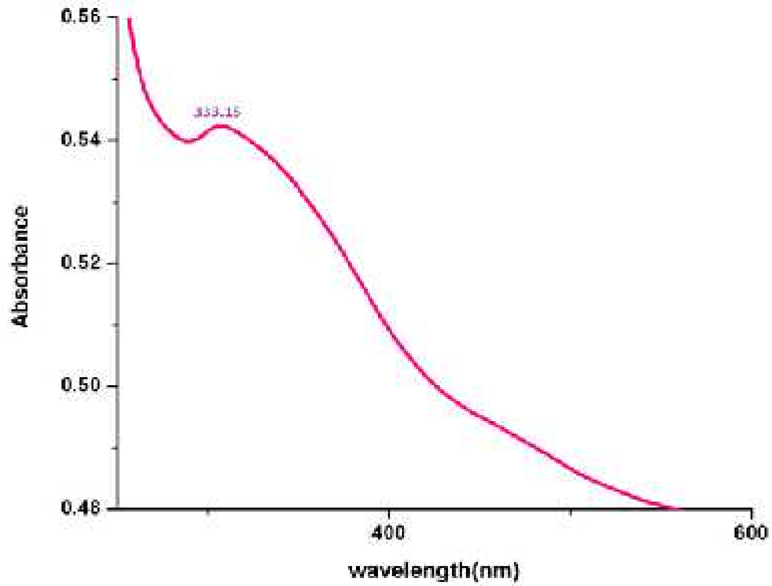

Fig 6. UV-Vis Spectra of Chemical Synthesized Nanoparticles

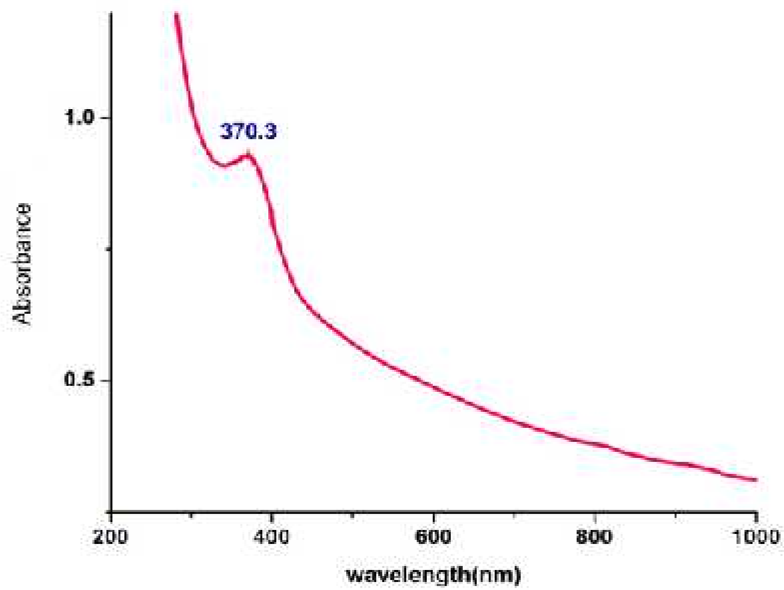

Fig 5. UV-Vis Spectra of Green Synthesized Nanoparticles

The band gap of ZnO nanoparticles was calculated by using formula

E = hc/λ

Where,

h is planck's constant($6.62\times10^{-34}\ m^2kgs^{-1}$)

C-velocity of light($3\times10^{8}\ ms^{-1}$) and

Λ-wavelength of light.

The band gap of zinc Oxide was found to be 3.34 eV and 3.72 eV as reported earlier.

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4 Conclusions

In summary we reported a synthesis of ZnO nanoparticles reduced and stabilized via Solanum Tuberosum (homemade starch rich potato extract) and sodium hydroxide. According to SEM results the green and chemical synthesized ZnO nanoparticles were formed in hexagonal structure and average particle size are 100-200 nm. The FTIR spectrum shows that the characteristic absorption peaks at 446-620 cm^{-1} which suggests the ZnO nanoparticles formation.

5. Future Scope

In future extend this work by using our home made recipe extracts from natural starch rich food sources such as rice, corn, and other grains sources for eco friendly nanoparticles preparation.

References

1. Swati, Kulkarni, Mahendra, Shirsat, International Journal of Advanced Research in Physical Science (IJARPS) Volume 2, Issue 1, January 2015, 14-18.
2. Sangeetha, Nagarajan, Kumaraguru, Arumugam, and Kuppusamy Journal of Nanobiotechnology, 2013, 1-11.
3. F.Buazara, M.Bavia, F.Kroushawib and S.A. Hossienid Journal of Experimental Nanoscience, 2016 Vol. 11, No. 3, 175-184.
4. D.Gnanasangeetha and SaralaThambavani D. Research Journal of Material Sciences Vol. 1(7), 1-8, August (2013).
5. P.vanathi, P.rajiv, Bull.mater.sci 39(2016), 1165-1170.
6. N.srinivasa rao, Mandava V. Basaveswara Rao American Journal of material science 2015, 5(3), 66-68.
7. Haritha Meruvu, Meena Vangalapati, Seema Chaitanya Chippada and Srinivasa Rao Bammidi J.com Vol.4, No.1 (2011), 217-222.
8. Harish Kumar, Renu Rani International Letters of Chemistry, Physics and Astronomy 14 (2013) 26-36
9. Agnieszka Kołodziejczak-Radzimska and Teofil Jesionowski *Materials* 2014, *7*, 2833-2881.
10. T. N. V. K. V. Prasad Journal of Plant Nutrition, 35:905–927, 2012.