OPTICAL PROPERTIES OF NANOCRYSTALLINE NIS NANOPARTICLES

R.Elayaperuma[l], Dr.A.Vanitha[2], M.Deepa[3], V.S.Sangeetha[4]

Assistant professor,

[1]Department of chemistry ,Dhanalakshmi Srinivasan College of Arts & Science for Women(Autonomous)

Perambalur

ABSTRACT

A hydrothermal method combining a calcination process was conducted to synthesize nickel sulphate(NiS)hierarchical architectureswithcontrollablemorphologiesandsizes.First,severalholl owNiShierarchicalarchitectures assembled by NiSnanosheets had been synthesized through the solvothermal method. The nucleationmediated mechanism overwhelmingly determined the morphology of hollowNiSarchitectures through tuning the nucleation rate. The NiSspheres could be formed in the case of high nucleation rate. However, NiS hierarchical architecture could be obtained from the precursor without changing their morphologies by a simple calcination procedure.

1.1INTRODUCTION

The word nanoscience refers to the study manipulation and engineering of matter, particles and structures on the nanometer scale. Moreover, in nanometer size structures these properties often different then on macro scale, because quantum mechanical effects become important. Hydrogen (H2) can be considered as the most promising fuel energy for the future, due to its high calorific value, regarded as a clean and sustainable energy source [1–3]. Though several methods are in practice for H2 generation, heterogeneous photocatalysis for water splitting has becoming a research hotspot throughout the world due to its simple process, works at ambient conditions and uses eco-friendly resources like water and light energy [4–8]. Among various photocatalysts developed so far, metal sulfides have been proven to be good candidates for H2 production from water under visible light [9–13]. In particular, NiO has been most commonly studied catalyst, due to its efficient absorption of visible light and having requisite band potentials for photocatalytic H2 generation [14–21]. Still the stability issues limit NiO for practical applications. Hence many researchers focused on material preparation, with different morphology, crystalline NiO and material modifications with transition metal oxides. There is a significant progress in water splitting on NiO based photocatalysts using solar light, especially in the development of co-catalysts. However, to the best of our knowledge, the synthesis of NiOnanocomposites for synergistic enhancing adsorption and photocataly properties has not been reported.Herein, novel satellite-like nanoparticles anchoring on porous NiOnanoplateswere fabricated by a step synthesis process. The structure and composition of sample were characterized through various analysis methods. Thanks to

the synergistic effect of NiOheterojunction, as-prepared NiOarchitecture exhibits excellent XRD efficiency.

l nanomaterial:

This type of material has one-dimension arrangement of atoms in the nanoscale range. The examples for one-dimension nanomaterial are surface coatings and thin films.

2. Two-dimensional nanomaterial:

This type of material has two-dimension arrangements of atoms in the nanoscale range. The examples for two-dimension nanomaterial are biopolymers, nanotubes, and nanowires.

3. Three-dimensional nanomaterial:

This type of material has three-dimension arrangements of atoms in the nanoscale range. The examples for three-dimension nanomaterial are fullerenes.

Owing to the importance of the nanomaterials as reviewed in the previous sections, it was observed that the rare Nickel oxides have been extensively investigated for their variety of potential applications. However, it has been noticed that the rare Nickel oxides were investigated limitedly for its electrochemical behavior. However, it has been observed that very limited literatures are available based on rare Nickel oxides doped with other rare oxides. It is also noticed from the recent literature that intensive investigations have been started to fill this gap. Hence, the present project is aimed to fill the gaps of literature with objectives for the synthesis and characterization of the following;

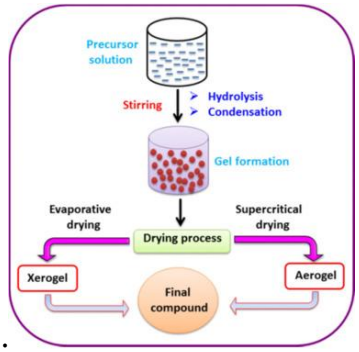
1. To Synthesize the NiOnanomaterial by co-precipitation technique.
2. To Synthesize NiO
3. To study the Properties of the synthesized NiO
4. To study the potential applications of the synthesized materials

MATERIALS AND METHODS

3.1 NICKEL SULPHATE

Nickel sulphate is a highly insoluble, thermally stable material and NiSsource is suitable for glass, optic and ceramic applications. sulfide compounds are not conductive to electricity.. NickelSulfide is generally immediately available in most volumes. Ultrahigh purity and high purity compositions improve both optical quality and usefulness as scientific standards..NiS has the highest thermo-dynamic affinity for oxygen, computer displays and automotive fuel sensors. NiO stabilized zirconia is used in high temperature applications and as an electrolyte in fuel cells. NiOis also available in pellets, pieces, sputtering targets, tablets, and nanopowder (from American Elements' nanoscale production facilities)..

coach, nature of metal precursor and solvent plays a remarkable role in the synthesis of metal oxides NPs.



3.4 AQUEOUS SOL–GEL METHOD

. Generally, metal acetates, nitrates, sulfates, chlorides, and metal alkoxides are employed as the metal precursors for this method. However, metal alkoxides are widely used as the precursors for the production of metal oxide NPs, due to high reaction affinity of alkoxides toward water (Bradley et al., 2001; Turova and Turevskaya, 2002). However, some difficulties are associated with the aqueous sol–gel method. The key steps, such as hydrolysis, condensation, and drying take place simultaneously in a number of cases resulting in difficulty in controlling particle morphology .The aforementioned difficulties, however, do not affect much of the synthesis of metal oxides in bulk, but strongly affect the preparation of nanooxides. Therefore, it is believed that the aqueous sol–gel route is highly recommended for the synthesis of bulk metal oxides rather than their nanoscale counterparts (Niederberger, 2007)

3.4 NONAQUEOUS SOL–GEL METHOD

In nonaqueous sol–gel process, oxygen required for the formation of metal oxide is supplied from the solvents, such as alcohols, ketones, aldehydes, or by the metal precursors. surface properties, particle size, and composition of the final oxide material. Although, nonaqueous sol–gel approach is not as popular as aqueous sol–gel method; nonaqueous sol–gel routes have shown excellent impact on the production of nanooxides compared to that of aqueous sol–gel route. The nonaqueous sol–gel route can be divided into two important methodologies, namely, surfactant-controlled and solvent-controlled approaches for the production of metal oxide NPs. Surfactant-controlled strategy involves direct transformation of metal precursor into the respective metal oxide at higher temperature range in hot injection method. This method permits outstanding control over the shape, growth of the NP, and avoids the agglomeration of particles. Few examples of surfactant-controlled synthesized NPs are mentioned here for understanding. Song and Zhang (2004) have demonstrated the simple nonhydrolytic route to synthesize high-quality spherical-shaped $CoFe_2O_4$ NPs with 8-nm size.. Heating rate and growth temperature played a pivotal role in controlling the shape of $CoFe_2O_4$ nanomaterial

The relative ratio between surfactant and $Fe(acac)_3$ showed a remarkable role in controlling the final morphology of $MnFe_2O_4$. TEM analysis revealed the formation of cube-

like or polyhedron-type morphology for $MnFe_2O_4$ (Fig. 1.6C–D). In addition, size of $MnFe_2O_4$ particle is dependent on the concentration of metal precursors. Novel cone-shaped ZnO was obtained by decomposition of TOPO–$Zn(OAc)_2$complex resulting in the formation of hierarchically ordered spheres of cone-shaped ZnOnanocrystals (Joo et al., 2005). Li et al. (2006)fabricated titanium oxide nanorods with 3.3-nm diameter and a length of 25 nm using appropriate amounts of reaction ingredients, such as titanium butoxide, triethylamine, linoleic acid, and cyclohexane. Reaction temperature, time, and concentration of the reactant were found to show huge effect on the shape and size of the TiONPs. Preparation of high-quality single crystalline MnOmultipods with homogeneous size and shape, involved decomposition of $Mn(oleate)_2$ in the presence of oleic acid and *n*-trioctylamine (Fig. 1.6E) (Zitoun et al., 2005). Solvent-controlled sol–gel route, involves the reaction between metal halide and alcohols to produce metal oxide nanostructures. For example, porous SnO_2 NPs were prepared by the addition of tin chloride to benzylalcohol under stirring condition, which was immediately dispersed in THF solution, producing sol. The subsequent addition of block polymer to sol allowed mesoporous nanostructure for SnO_2 by the elimination of solvent molecule (Ba et al., 2005).

carbon tetrachloride pollution in ground water can be removed using iron nanoparticles, and arsenic present in water wells can be removed using iron oxide nanoparticles.

4.5.5 Energy and Electronics

Researchers are exploring the use of nanotechnology to generate more efficient and cost-effective energy. When sunlight is concentrated on nanoparticles, it creates steam with high energy efficiency. . These innovative bulbs are shatterproof and have double the efficiency of fluorescence light bulbs. Attempts are also being made to develop high-efficiency LEDs using arrays of nano-sized structures known as plasmonic cavities. Similarly, windmill blades are being developed using epoxy containing carbon nanotubes. These nanotube-filled epoxies help to create stronger yet lightweight blades, which boost the amount of electricity produced by individual windmills. These nanotube sheets can be enclosed around a car's exhaust pipe to produce electricity from heat which is otherwise wasted.

Nanotechnology is employed in many different electronics, communications, and computing applications, providing smaller, faster, and more portable systems. These systems can store large amounts of data. Some examples of nanoelectronics are cell phone castings, flash memory chips for iPod nano's, antibacterial and antimicrobial coatings on keyboard and mouse, etc. Nanotechnology is used in smart cards, printed electronics for RFID, and smart packaging, as well as in flexible displays for e-book readers and life-like video games. In the future, the entire memory of a computer may be stored on a just one small chip. .

SUMMARY

In summary, the effect of calcination on the structural and optical properties of nanocrystallineNiS nanoparticles were successfully synthesized by virtue of a single source precursor method at mild reaction conditions between nickel nitrate and sodium hydroxide.

5.2 REFERENCES

1. Andelman T, Gordonov S, Busto,GMoghe, PV &Riman RE (2010), 'Synthesis and cytotoxicity of Y_2O_3 nano particles of various morphologies', Nanoscale Research Letters, vol. 5, pp. 263-273.

2. Atabaev TS, Hwang YH & Kim, HK(2012), 'Color tunable properties of Eu^{3+} and Dy^{3+}Codoped Y_2O_3 phosphor particles', Nanoscale Research Letters, vol. 7, pp. 556-562.

3. Bren-necke JF & Allen DT (2002), 'Green chemistry and engineering: Preface', Ind. Eng. Chem. Res., vol. 41, pp. 4439-34.

4. Brett DJL, Atkinson A, Brandon NP & Skinner SJ (2008), 'Intermediate temperature solid oxide fuel cells', Chem. Soc Rev., vol. 37, pp. 1568-1578.

5. Cai W, Chen Q, Cherepy N, Dooraghi A, Kishpaugh D, Chatziioannou A, Payne S, Xiang W & Pei Q (2013), 'Synthesis of bulk-size transparent gadolinium oxide–polymer nanocomposites for gamma ray spectroscopy', Journal of Material Chemistry C, vol.1, pp.(1970-1976).

6. O. Bicakova, P. Straka, ActaGeodyn. Geomater. 7 (2010) 175–188.

7. [2] Y. Ma, X. Wang, Y. Jia, X. Chen, H. Han, C. Li, Chem. Rev. 114 (2014) 9987–10043.

8. [3] H.M. Gobara, I.M. Nassar, A.M.A. El Naggar, G. Eshaq, Energy 118 (2017) 1234–1242.

9. A. Kudo, Y. Miseki, Chem. Soc. Rev. 38 (2009) 253–278.

10. M. Kitano, M. Hara, J. Mater. Chem. 20 (2010) 627–641.

11. Lakshmana Reddy et al. Materials Research Bulletin 101 (2018) 223–231

12. Y. Guo, Y. Li, S. Li, L. Zhang, Y. Li, J. Wang, Energy 82 (2015) 72–79.

13. D. Zhou, Z. Chen, T. Gao, F. Niu, L. Qin, Y. Huang, Energy Technol. 3 (2015) 888–895.

14. N. Lakshmana Reddy, S. Emin, V. Durga Kumari, M.V. Shankar, Ind. Eng. Chem. Res. 57 (2018) 568–577. [9] X. Chen, W. Shangguan, Front

15. Divya S. Synthesis and Characterization of Pure and Samarium doped Y_2O_3 Nanoparticles, M. Phil., Thesis Submitted to Thiruvalluvar University,(2017)

16. Fajardo HV, Longo E, Leite ER, Libanori R, Probst LFD &Carreno NLV (2012), 'Synthesis, characterization and catalytic properties of nanocrystalline Y_2O_3-coated TiO_2 in the ethanol dehydration reaction', Materials Research, vol. 15, no. 2, pp. 285-290.

17. Gyuk I, Kulkarni, P Sayer, JH Boyce, JD Corey, GP & Peek GH (2005), 'The United States of Storage', IEEE Power and Energy Magazine, vol. 3, no. 2, pp. 31-39.

18. Harvey D. (2000), Modern Analytical Chemistry. McGraw-Hill,

19. He T, Wei W, Ma L, Chen R, Wu S, Zhang H,Yang Y, Ma J, Huang L, Gurzadyan, GG & Sun H(2012), 'Mechanism Studies on the Superior Optical Limiting Observed in Graphene Oxide Covalently Functionalized with Upconversion $NaYF_4$:Yb^{3+}/Er^{3+}Nanoparticles, Small, vol.8, pp.2163-2168.