© 2018 IJSRSET | Volume 4 | Issue 6 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

A Review on Tio_2, Sio_2 and Tio_2-Sio_2 Nanocomposite Synthesis and its Applications

Aiswarya Lekshmi . G, Dr. Sandhya Pillai
Department of Nanotechnology,CCET,Bhilai, Durg, Chhattisgarh, India

ABSTRACT

In past few years, antireflection sol-gel coatings have been an area of great interest and attracted researchers as they are reliable due to their low cost and also find potential applications in a variety of commercial purposes. Oxides of higher refractive index such as zro_2, tio_2 and Ta_2O_3 and oxides of lower refractive index such as sio_2 finds application in various fields like fabrication of various types of coated optics and different optical filtering.tio_2 photocatalytic coatings are extensively known for their amazing behavior of self cleaning using hydrophilic surface which can easily wash off dirt particles.sio_2 and tio_2 shows unique and highly tunable optical and photocatalytic properties. Various techniques are used by researchers for the synthesis of tio_2, sio_2 and tio_2-sio_2 nanocomposite. In this paper we will be going through most of the available synthesis techniques used by researchers and its applications in various fields.

I. INTRODUCTION

Nanotechnology had become an area of great interest finding applications in various fields and is creating miracles with its unique properties and specialties in nano range. Nanomaterials play a vital role in the field of nanotechnology in the form of nanoscale particles, tubes , rods or fibers and are finding applications in various fields like- Electronics, Cosmetics, Health care, Information Technology, Textiles and Environmental Protection. The characteristics and specific functions of nanoparticles may be controlled and varied af per the requirement by varying their shape and size at the nanometer scale.

Sio_2 and tio_2 nanomaterials have been an area of wide research in the past few years due to its amazing properties in self cleaning and photocatalytic applications. Also due to their relative low cost they find potential application for a variety of purposes such as Solar cells, wind screens, thermal collectors, architectural glasses, high power lasers and video display panels. Photocatalytic coatings of tio_2 nanoparticles are well known due to their excellent self cleaning behavior.[1] sio_2 and tio_2 core shell nanoparticles (csns) have attracted great attention due to their highly unique and tunable optical and photocatalytic properties and also higher dispersion of the supported tio_2. Thus, development of facile, reproducible and effective techniques for the synthesis of sio_2 and tio_2 csns and a fundamental understanding of their improved properties, achieved from combination of different core and shell materials, is of great significance.[4]. Wide area of applications are available including the photocatalytic and self cleaning property.

Various methods for the synthesis of sio_2-tio_2 nanoparticles are also available like Sol gel method, Pulse laser deposition, Electrochemical route ,Chemical co-precipitation method, Solid state reaction method, Thermolysis, Chemical bath deposition method and Spray pyrolysis method.

SYNTHESIS OF tio_2, sio_2 and tio_2-sio_2

II. NANOCOMPOSITE

Although many synthesis techniques are available and have been used by the researchers but the most frequently used synthesis technique is the Sol-gel method. In a research work silica nanostructures was synthesized using sol-gel method and the the two parameters considered are aging time and the calcinations temperatures and the average particle size of silica was in the range of 79.68 nm to 87.35 nm.[1] The sol-gel method has been widely used as a substitute technology in preparing monoliths, powders, coatings and fibers. Another researcher had used sol- gel method in which tio_2- sio_2 have been prepared by the sol-gel method by using titanium isopropoxide and varied silica precursors: tetraethyl orthosilicate and tetra methyl ortho silicate.[4]

Mesoporous tio_2, sio_2 nanoparticles and tio_2/sio_2 nanocomposites were successfully synthesized by sol–gel method in which Titanium (IV) isopropoxide, tetra-ethylorthosilicate were used as starting materials. Mesoporous materials are of great interest as catalysts because of their unique textural and structural properties. The UV–Vis spectrum of the synthesized samples shows similar absorption in the visible range. The tio_2/sio_2 nanocomposite's BET surface area is found to be 303 m^2/g. The average Pore diameter is about 10nm.[5] Another research using Sol-gel method was done in which tio_2 and sio_2 nanoparticles are first synthesized and then the superhydrophobic self cleaning sio_2/tio_2 layers are fabricated on glass. The synthesis of sio_2 and tio_2 nanoparticles was done using chemical method.[5]
In a research done in 2012 Broadband antireflective coatings via the design concept of three

Layer interference coating i.e sio_2–tio_2, tio_2 and nanoporous tio_2–sio_2composite thin films were employed as bottom, middle and top layers.[9] In a research Silicon based solar cells have been fabricated for single layer sio_2 and double layer sio_2/tio_2 antireflective coatings (ARC) using RF sputtering technique. A research work was done in 2014 in which Sol-gel method and

Dip coatings method was used in combination to form multilayer tio_2-sio_2 coatings on both sides of the glass substrates [15]. Tio_2 nanoparticles are synthesized using simple Sonochemical method in a research work done in 2007. The mean diameter of the synthesized nanoparticle is about 20nm. It is initially treated with 10M naoh solution aqueous solution [17]. Titanate nanoparticles synthesis using Hydrothermal reaction is also carried in which tio_2 and naoh is used as the precursors and the calcinations temeratur is set to 500^0C for 4hrs.[14]

III. APPLICATIONS IN VARIOUS FIELDS

Sio_2,tio_2 nanomaterials individually as well as when used as composites shows unique properties which makes it an an area of great interest and hence finds as wide area of applications including Electronics, Cosmetics, Health care, Information Technology, Textiles and Environmental Protection. Many researchers have worked on the application of these materials in different fields due its highly tunable and amazing properties.

Sio_2, tio_2 nanomaterials are used to develop thin films and coatings which have been used by the researchers as an area of application on glass substrates etc. Also a researcher used sio_2 as nanofluids for cooling applications in Fuel cell (Polymer Electrolyte Membrane Fuel Cells i.e PEMFC) as their operation is very much sensitive to micro electrochemical changes and can only tolerate a small temperature variation. Sio_2 nanofluids act as a cooling agent in the thermal management in such conditions. Titanium dioxide is well known semiconductor material in some applications which includes photocatalysis and dye-sensitized solar cells which are used to enhance its performance, some modifications have been investigated by such chemical and physical treatment.[4]

Photocatalytic degradation of methylene blue dye (MB) was studied making use of the Titanate nanoparticles in which it is exposed to UV light inside a tubular reactor. [14] Another research work based on the self cleaning and hydrofobicity of wool fabrics was analysed in areserch work done in 2012 for coffee stain removal.under UV and water contact angle respectively.

IV. CONCLUSION

Various researchers had used different synthesis techniques and had used for various applications. The main area of application focused by researchers are for self cleaning and on photocatalytic properties. Although Sol-gl method is the most widely usd synthesis technique various researchers hav worked on the different synthesis techniques under various circumstances so as to get the required nanomaterial or composites under available resources.

V. REFERENCES

[1]. H.N. Azlinaa, J.N. Hasnidawania, H. Noritaa and S.N. Suripb," Synthesis of sio2 Nanostructures Using Sol-Gel Method", ACTA PHYSICA POLONICA A, Vol. 129 (2016),

[2]. Haihong Ma , Tiejun Shi and Qiusheng Song, "Synthesis and Characterization of Novel PVA/sio2-tio2 Hybrid Fibers", Fibers 2014, 2, 275-284; doi:10.3390/fib2040275, ISSN 2079-6439

[3]. Herny Ariesta Budiartia, Rizky7 Nanda Puspitasaria , Agus Muhamad Hattaa, Sekartedjoa and Doty Dewi Risantia, "Synthesis and Characterization of tio2@sio2 and sio2@tio2 Core-Shell Structure Using Lapindo Mud Extract via Sol-Gel Method", Science Direct Procedia Engineering 170 (2017)

[4]. I Fatimah, "Preparation of tio2- sio2 via sol-gel method: Effect of Silica precursor on Catalytic and Photocatalytic properties", IOP Conf. Ser.: Mater. Sci. Eng. 172 012025

[5]. D. Arun Kumar, J. Merline Shyla, Francis P. Xavier, "Synthesis and characterization of tio2/sio2 nano composites for solar cell applications", Appl Nanosci (2012) 2:429–436 DOI 10.1007/s13204-012-0060-5

[6]. Khuram Ali, Sohail A. Khan, M. Z. Mat Jafri, "Effect of Double Layer (sio2/tio2) Anti reflective Coating on Silicon Solar Cells", International Journal of ELECTROCHEMICAL SCIENCE, 9 (2014) 7865-7874.

[7]. M. Farahmandjou, P. Khalili, "Study of Nano sio2/tio2 Superhydrophobic Self-Cleaning Surface Produced by Sol-Gel", Australian Journal of Basic and Applied Sciences, 7(6): 462-465, 2013 ISSN 1991-8178.

[8]. Magnum Augusto Moraes Lopes de Jesus, João Trajano da Silva Neto, Gianluca Timò, Paulo Renato Perdigão Paiva, Maria Sylvia S Dantas , Angela de Mello Ferreira, "Superhydrophilic self-cleaning surfaces based on tio2 and tio2/sio2 composite films for photovoltaic module cover glass", Applied Adhesion Science (2015) 3:5 DOI 10.1186/s40563-015-0034-4

[9]. Yuanyang Li, Ke Yang, Bibo Xia,Bowen Yang, Lianghong Yan,Meiying He, Hongwei Yan, Bo Jiang, "Preparation of mechanically stable triple-layer interference broadband antireflective coatings with self-cleaning property by sol–gel technique", Royal Society of Chemistry, DOI: 10.1039/c7ra00844a rsc.li/rsc-advances

[10]. Sanjay S. Latthe, Shanhu Liu, Chiaki Terashima, Kazuya Nakata and Akira Fujishima, " Transparent, Adherent, and Photocatalytic sio2-tio2 Coatings on Polycarbonate for Self-Cleaning Applications", Coatings 2014, 4, 497-507; doi:10.3390/coatings4030497

[11]. Esfandiar Pakdel,, Walid A. Daoud, Xungai Wang, "Self-cleaning and superhydrophilic wool by tio2/sio2 nanocomposite", Applied Surface Science 275 (2013) 397– 402

[12]. Bruna Andressa Bregadiollia, Silvia Leticia Fernandesa,b, Carlos Frederico de Oliveira Graeff . " Easy and Fast Preparation of tio2 -

based Nanostructures Using Microwave Assisted Hydrothermal Synthesis" Materials Research. 2017; 20(4): 912-919

[13]. Ping Xiao, Robert Dorey "Nanostructured thin films and coatings" Hindawi Publishing Corporation Journal of Nanomaterials Volume 2008, Article ID 931380.

[14]. Aghareed M. Tayeb, Dina S. Hussein "Synthesis of tio2 Nanoparticles and Their Photocatalytic Activity for Methylene Blue" American Journal of Nanomaterials, 2015, Vol. 3, No. 2, 57-63

[15]. Najme Lari, Ali Shanaghi, Sh. Ahangarani "Effect of different tio2 –sio2 Multilayer coatimgs applied by Sol-Gel method on Antireflective property" Journal of Materials Engineering &Performance July 2015

[16]. M. MAZUR, D. WOJCIESZAK, J. DOMARADZKI, D. KACZMAREK, S. SONG, and F. PLACIDO "tio2/sio2 multilayer as an antireflective and protective coating deposited by microwave assisted magnetron sputtering" OPTO–ELECTRONICS REVIEW 21(2), 233–238

[17]. Hamed Arami, Mahyar Mazloumi, Razieh Khalifehzadeh, S.K. Sadrnezhaad "Sonochemical preparation of tio2 nanoparticles" Science Direct Materials Letters 61 (2007) 4559–4561