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17th & 18th December, 2018

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Intellectual Property Rights, Trips and India: Addressing Critical Concerns in Access to Medicines

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Abstract: Intellectual Property Rights has become a topic of crucial concern in various fora of discussion across the world because of the imminent implications of its legislations on the basic rights of the people. The paper proposes to address the critical concerns faced by India in the realm of health following the adoption of national legislations in compliance with the TRIPS Agreement. The paper is drafted in three sections- an overview of the genesis of the concept of IPR at the international and national levels; brief analysis of the major amendments in the Indian Patent and other IPR legislations made in compliance with the TRIPS Agreement; detailed review of the challenges and opportunities opened up by the new global IPR regime in the realm of pharmaceuticals and health care in India as a human rights concern, in a global context.

Keywords: Intellectual Property Rights, TRIPS, Right to Health, Access to Medicines, India, Generic Drugs.

I. Introduction

THE right to appropriate or own property has been a crucial determinant in the history of human interactions in political, social and economic contexts. The expression of knowledge as (intellectual) property has not been devoid of controversies. The crucial developments in the realm of technology influenced the genesis and growth of intellectual property into one of the most determining aspects of international political and economic order. The nature and content of the debate over the conceptualisation of knowledge property acquired a decisive lift at the end of the twentieth century, especially after the Uruguay Round of GATT negotiations which lead to the adoption of the Agreement on Trade Related Intellectual Property Rights (TRIPS Agreement).

Amongst the developing countries, India is considered to be one of the most affected by the TRIPS Agreement and related developments. The dramatic reconstitution of the Indian Patents Act, 1970, to comply with the TRIPS Agreement, has turned the table against the rights-based development agenda of the country in all realms of social welfare. The possibilities of utilizing the flexibilities envisaged by the Doha Declaration on the TRIPS Agreement and Public Health, 2001, are still unclear and are restricted by unethical interventions of the developed countries and TNCs. India has also been experiencing intense challenges in protecting its traditional medicine/knowledge.

The paper proposes to address the critical concerns faced by India in the realm of public health following the adoption of national legislations in compliance with the TRIPS Agreement. The paper is drafted in three sections- an overview of the genesis of the concept of IPR at the international and national levels; brief analysis of the major amendments in the Indian Patent Act made in compliance with the TRIPS Agreement; detailed review of the challenges and opportunities opened up by the new global IPR regime in the realm of pharmaceuticals and health care in India as a human rights concern, in a global context.

II. TRIPS Based New IPR Regime and Impact on Access to Medicines

The conceptualisation of the notion of knowledge as intellectual property assumed international dimensions with the adoption of the Paris Convention on Industrial Property (1883) and Berne Convention on Literary and related works (1886). Since then, various other international agreements were executed to incorporate more and more areas of knowledge under the purview of property rights. Until the early half of the twentieth century, all these protection mechanisms worked independently, and was monitored by World Intellectual Property Organisation which is a special agency of the United Nations Organisation. But, with the research and capital intensive New Generic Technologies (Information and Communication Technology, Biotechnology and New Materials) attaining significant stake in global trade, the Transnational Corporations compelled the developed countries to incorporate intellectual property rights into the ambit of the Uruguay round of GATT negotiations. The outcome was the adoption of a universal agreement encompassing all forms of intellectual property- the Agreement on Trade Related Intellectual Property Rights under the aegis of the World Trade Organisation (WTO) (May & Sell 2006). Since the beginning of the 21st century, the new global IPR regime constituted by the TRIPS Agreement has been expanding its scope and impact through multiple TRIPS-plus standards (Geethika 2018).

Though the advocates of the new regime claim that it is to the benefit of all to have a global intellectual property regime according to the mandates of the trade standards for the maximum utilization of the creations of the mind, doubts still prevail about the long-term and short-term implications of this move upon the technological and economic progress of the developing countries.

The concerted efforts of a few developed countries to relocate a concept, thus far considered a parameter for encouraging individual endeavours, into the ambit of trade negotiations has been observed as an illustration of institutional imperialism. There are many who strongly believe that intellectual property protection mechanism is essential for promoting innovation in the pharmaceutical industry, given the need to continue discovering and

developing new drugs (Attaran 2004). But, the challenge raised by the new IPR regime on health is two-pronged: access and affordability. When the pharmaceutical companies try to monopolise the drug industry, not only does it make essential medicines unaffordable to the poor, but also shifts the focus of R&D towards drugs for lifestyle diseases which fetch exorbitant prices in the market (Geethika 2018).

The TRIPS Agreement contains eight parts and 73 articles of which Articles 27 to 34 are specifically of implications to access to affordable medicines and public health. The introduction of product patents (Article 27.1), for 20 years (Article 33), into the IPR framework broadens the scope of patentability, especially since TRIPS breaks the tradition of earlier patent laws and insists the extension of patentable subject matter to all fields of technology including pharmaceuticals (subject to Article 65.4, Article 70.8 and Article 27.3) (Musungu & Oh 2005).

The Agreement states that governments can refuse to grant patents for three reasons that may relate to public health (WHO 2006): (a) inventions whose commercial exploitation needs to be prevented to protect *ordre public* or morality (Article 27.2); (b) diagnostic, therapeutic and surgical methods for treating humans or animals (Article 27.3a); and plants and animals other than micro-organisms (Article 27.3b).

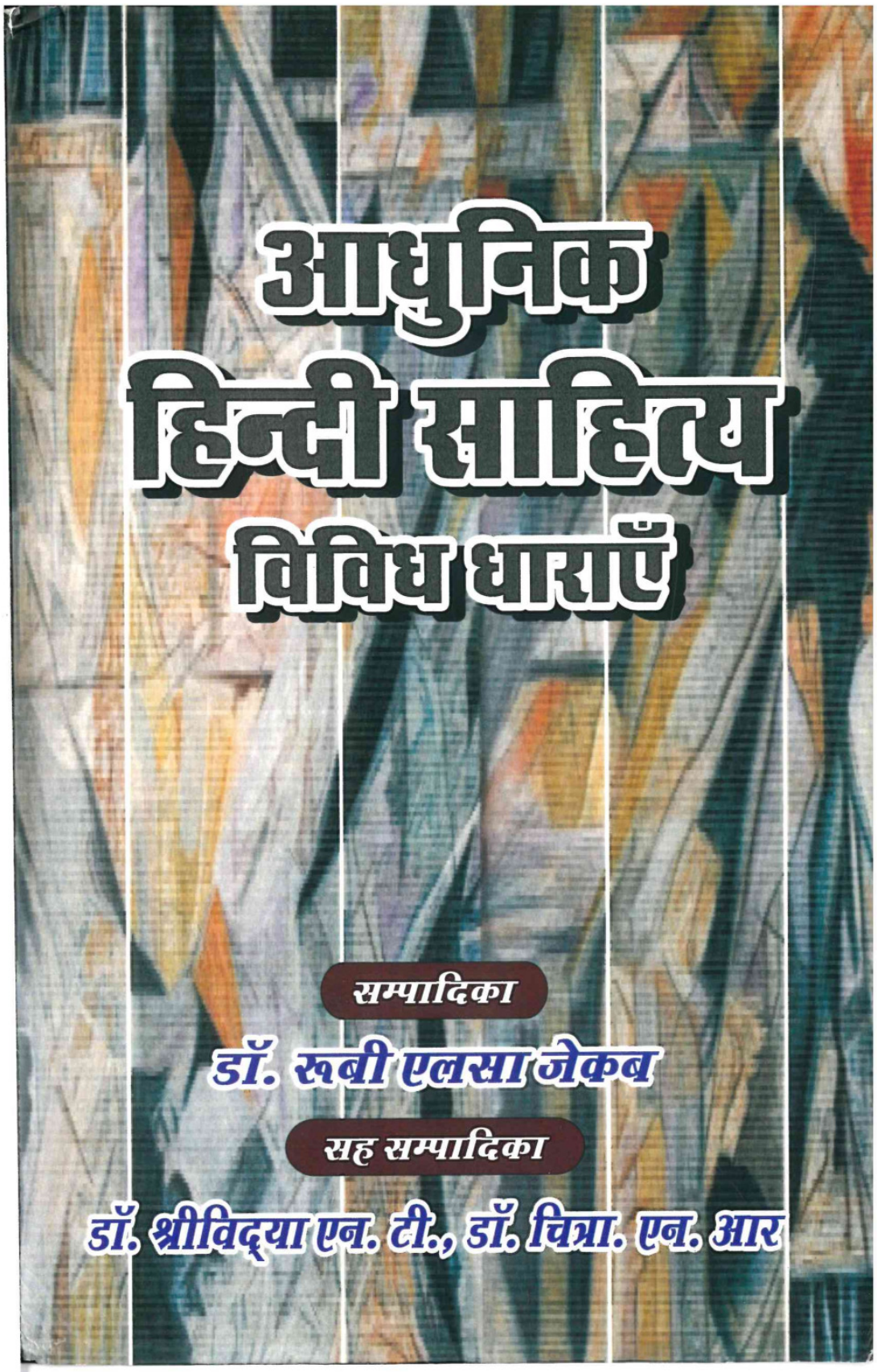
But, it is evident beyond much doubt that the extension of the scope of IPR into the realm of the pharmaceutical sector has influenced the public health system of developing countries in different ways. The TRIPS Agreement provides option to import patented product thereby freeing the pharmaceutical companies from having to transfer the related technology, thereby denying the developing countries the access to technology. Since patents inevitably lead to monopoly, if patentees hesitate to introduce drugs at low prices in the initial years of global marketing, access to innovative pharmaceuticals may actually be delayed in poor countries. The cartelization and monopolisation inevitably increases the drug price to unaffordable levels. Product patenting restricts generic drug industry from producing affordable versions of important life-saving drugs. It has been found that pharmaceutical research is now being devoted to develop highly profitable drugs for lifestyle diseases. Similarly, only a marginal few of the new drugs are New Molecular Entities or 'innovative drugs' composed of truly new chemical compounds instead of chemical derivatives or new formulations or combinations of old drugs. The imposition of TRIPS-plus standards on developing countries and LDCs through bilateral/regional trade and investment agreements as well as WTO accession agreements, can significantly undermine the existing TRIPS flexibilities (Geethika 2018).

III. The New IPR Regime and India's Public Health Concerns

It was during the British rule that IPR was introduced into our legislations. After independence, the Indian Patent Act of 1970 was drafted with much care sensitive to the needs of the country. The Act was a widely transformative legislation and the industrial sector most benefitted was the pharmaceutical industry, generic sector in particular. Through the 1970s, the Indian pharmaceutical industry grew from its formerly meagre existence, with a low production base, heavy dependence on imports, domination by foreign firms and high prices of drugs, to being one of the largest pharmaceutical industries in the world. Some appealing features of the Indian pharmaceutical industry were self-reliance in production with world class manufacturing facility at multi-national level; and cost effective means to procure generic and off-patent drugs (Geethika 2018).

The industry could boast that out of the 465 main bulk drugs used in India, around 425 bulk drugs were manufactured in India and 60 of them were exported too. Process patents and reverse engineering helped ensure unrestricted supply of all new drugs into the Indian market with very little 'drug lag'. Possibilities of accessing pre-clinical documentation helped Indian drug companies launch many medicines far ahead of their original innovators. Some good examples are *Atenolol, Diclofenac, Alprazolam, Cimetidine, Ranitidine, Famotidine* etc. (Ekbal 2013; Joseph 2016). India became a world leader in the manufacture and export of basic drugs such as *Ethambutol and Ibuprofen*. The industry has also contributed to the development of new drugs such as *Tromovill, Cibenid and Centbucridines* as well as the development of innovative process technologies for known drugs. The biggest contribution of the Indian generic drug industry is that since 2001 India has been able to supply generic anti-retroviral drugs to many countries and the prices have since then reduced significantly. When Cipla introduced the triple cocktail of antiretroviral drugs (*stavudine + lamivudine + nevirapine*) in 2001 at US$350 per person per year, the originator company's price for the drug in developing countries fell from US$10,000 to US$727. Patients in all continents, except maybe Europe and Australia, rely on India for exported medicines and the United States of America is the largest importer in terms of value (Geethika 2018). The adoption of the TRIPS Agreement put India under severe compulsion to rework on our legislations. The pressure on India has been to amend or correct the following provisions of the Patents Act, 1970: (i) restoration of patent term to 20 years; (ii) introduction of product patents and reversal of the burden of proof; (iii) dilution of compulsory licensing provisions; (iv) removal of 'licences of right' clause; (v) extension of patentability to biotechnology, agricultural or horticultural inventions; and extend the protection to geographical indications, integrated circuits and trade secrets for which India had no legislation until then (Nair 1996).

The first amendment came in 1999, with retrospective effect from January 1, 1995. Being a country with no history of awarding product patents to pharmaceuticals and chemical inventions, the amendment had to make provisions to accept 'mail box' applications, grant exclusive marketing rights (EMR), shift the burden of proof to alleged infringer and extend protection to imported materials and products. About 84 percent of the mailbox applications were made by foreign (i.e., non-Indian) entities (Ragavan 2001).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सह सम्पादिका
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ISBN : 978-93-86248-59-6

पुस्तक	:	आधुनिक हिन्दी साहित्य विविध धाराएँ
लेखिका	:	डॉ. रूबी ऐलसा जेकब, डॉ. श्रीविद्या. एन.टी. डॉ. चित्रा. एन.आर.
प्रकाशक	:	**विद्या प्रकाशन** सी-449, गुजैनी, कानपुर-22 दूरभाष : (0512) 2285003 मो० : 09415133173 Website: www.vidyaprakashankanpur.com E-mail : vidyaprakashan.knp@gmail.com
संस्करण	:	प्रथम 2018
शब्द सज्जा	:	शिखा ग्राफिक्स, कानपुर
मुद्रक	:	श्री पूजा प्रिन्टर्स, कानपुर
मूल्य	:	₹ 595/-

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विभाजन साहित्य में अभिव्यक्त स्त्री की व्यथा–कथा

डॉ. रूबी एलसा जेकब

15 अगस्त 1947 को भारत का विभाजन हो गया लेकिन यह विभाजन , निः संदेह इतिहास की एक बहुत बड़ी त्रासदी बनकर रह गयी । अमानवीय कारनामों का न खत्म होनेवाला सिलसिला शुरू हो गया । इस घटना के इतने दूरगामी परिणाम हुए कि इसने भारत के अतीत , वर्तमान के साथ भविष्य को भी अपने आगोश में ले लिया । दुःख – तकलीफों , यातनाओं और संघर्षों का एक नया सिलसिला शुरु हुआ और लोगों की समझ में आने से पूर्व ही लाखों – करोड़ों के जीवन साँप्रदायिकता की आग में झुलस गये । विभाजन के ऐन वक्त और बाद में जो नरसंहार हुआ , वह भारतीय इतिहास की एक करुण त्रासद घटना है ।

विभाजन , स्वतंत्रता का सबसे बड़ा अभिशाप बनकर उपस्थित हुआ । जो लोग भारत की आज़ादी को मात्र सत्य , अहिंसा तथा शांति से प्राप्त वस्तु समझते हैं , उन्हें अपने विचार में परिवर्तन लाना होगा कि भारत की स्वतंत्रता , रक्तहीन क्रांति से प्राप्त नहीं हुई है , उसके मूल्य के रूप में राष्ट्र को 'महारक्तदान करना पड़ा । बँटवारा , एक चट्टान की तरह लोगों के सिर पर टूटा था और जब तक साँस ले पाते , कुछ सोच पाते – सदियों से अर्जित एक राष्ट्र का जज़्बा , साँस्कृतिक एकता , जातीयता , मानवीय संबंध सब सांप्रदायिक आग की लपेटों में जलकर राख हो गए थे ।

भारत – विभाजन को लेकर जो नरसंहार हुआ , वह न केवल देश के माथे पर बल्कि सारी मानव – जाति पर बहुत बड़ा कलंक है । इस समय की स्थितियों का वर्णन, डॉ. राम मनोहर लोहिया ने इन शब्दों में कही है – " विभाजन के समय छह लाख बच्चे , औरतें और मर्द मारे गए। उन्हें मारने , बलात्कार और अत्याचार के लज्जापूर्ण और क्रूरतापूर्वक ढंग , पागलों की तरह अपनाये गये। डेढ़ करोड़ लोग उजड़े और पुनः बसने के लिए उन्हें ऐसे इलाकों में आबाद होना पड़ा , जहाँ न स्वागत करनेवाला कोई शुभचिंतक था , न कोई पूछनेवाला हितैषी ।

Transforming Psychology

Department of Psychology
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ISBN: 978-1985783072

9 781985 783072

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Chapter Two

Health Issues Among Tribal Students[2]

Introduction: Physical health of an individual cannot be separated from his / her mental health. Each one affects other in complex ways. Health psychologists are increasingly exploring how physical health and mental health works together for the wellbeing of a person's psychological and physical standards. Symptoms of poor mental health can be disruptive to a person's daily life and limit potential and place stress on relationships. Accessibility to better physical and psychological health is not found to be evenly distributed to people in our country. The issue is of utmost importance when it comes to the plight of minority groups, such as tribal students in India. Scheduled tribes refer to a group of historically disadvantaged people who are descendents of the tribal communities. They do not believe in caste system but dwell in deep inside forest far away from the chief part of the society (Srivastava, Srivastava, & Ramasamy, 2013). It has been indicated that India has a long way to go to improve its health status (Mahajan 1996, World Development Report 1993). Periodic Food Consumption Surveys reveal the poor nutritional status of the Indian population. This problem is further aggravated by communicable diseases establishing the vicious cycle of malnutrition and infections (Bhaskaram, 1996, Reddy et al. 1993). The issue is increasingly complex in the case of Scheduled Tribes in the state of Kerala.

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Global IPR Regime & PUBLIC HEALTH

India's Tryst with TRIPS

G. Geethika

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PUBLICATIONS PVT. LTD
B-7, Saraswati Complex, Subhash Chowk,
Laxmi Nagar, New Delhi 110092
Phone: 22453894, 22042529
E-mail : manak.publications@gmail.com
Website: manakpublications.in

Subsidiary Office in USA
MANAK PUBLICATION, INC.
8145 Kolb Ave, Allen Park, M.I. 48101 USA
E-mail: manakpublications.USA@gmail.com

First Edition 2018

ISBN 978-93-7831-456-8

Laser Typeset by: Tabrez Ali, Aadil Printographics, Delhi
Printed in India by: Nice Printing Press, New Delhi (India)

Contents

Synthesis and characterization of photoconducting (Cd:Zn)S thin films by hydrothermal assisted chemical bath deposition

Joissy Mathew, Sebin Devasia, and E. I. Anila

Citation: AIP Conference Proceedings **1942**, 080080 (2018); doi: 10.1063/1.5028914
View online: https://doi.org/10.1063/1.5028914
View Table of Contents: http://aip.scitation.org/toc/apc/1942/1
Published by the American Institute of Physics

Synthesis and Characterization of Photoconducting (Cd:Zn)S Thin Films by Hydrothermal assisted Chemical Bath Deposition

Joissy Mathew[1,2], Sebin Devasia[2] and E. I. Anila[2,a]

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Abstract. We report the synthesis of polycrystalline ternary (Cd:Zn)S thin films by hydrothermal assisted chemical bath deposition on glass substrates. X-ray diffraction reveals the hexagonal phase of cadmium zinc sulphide (CZS)film with preferred orientation along the (002) plane and the average grain size to be 22.78 nm.SEM image shows clusters of nano fibers grown on the film.The optical band gap obtained from the optical absorption studies using UV-Vis-NIR spectroscopy is 3.4 eV. Broad and asymmetric emission due to the combination of near band edge emission and emission fromintrinsic point defects was observed in the PL spectrum.The filmexhibit photoconductivityunder illumination by light from 32 watts halogen bulb. In dark condition, the I–V curve shows non-linear behavior, whereas ohmic behavior under illumination. The Photo response of film was recorded for the light-on and light-off conditions at intervals of 100 secondswhen 10V voltage was applied. We observed fast rise and decay of the photocurrent depictinghigh photosensitivity. This work present a simple way to obtain photo-detectors and will benefit in optical-electron devices manufacture.

INTRODUCTION

The interest in the investigation of II-VI semiconducting thin films of CdS, ZnS and their ternary alloys $Cd_xZn_{1-x}S$ are increased extensively in recent years due to their application in photovoltaics, photoelectrochemical energy conversion and photoconductors[1].These compounds are promising materials for high density optical recording and for blue and even UV laser diodes. (CZS) films have been widely used as a wide band gap window material in heterojunction solar cells and in photoconductive devices [2-4]. (CZS) could be used in optoelectronic applications within the visible to UV spectral range, and also in solar energy driven devices [5]. (CZS) films exhibit fundamental absorption edges that can be varied from green to UV [6]. In solar cells where CdS films have been demonstrated to be effective, the replacement of CdS with the higher band gap(CZS) alloys has led to a decrease in window absorption loss and increase in short circuit current [7]. The tunable band gap with constituent stoichiometries of the film is the attraction of the researchers in the investigationof $Cd_xZn_{1-x}S$ thin films [8]. In this work, we explored the synthesis of highly photosensitive (Cd:Zn)S thin films via hydrothermal processes along with its structural, morphological and optical characterization. The hydrothermal processing has lots of advantages and can be used to give high product purity, homogeneity, crystal symmetry, narrow particle size distributions etc. The method is preferable due to its simplicity and cost effectiveness[9].

EXPERIMENTAL

The chemical bath contained aqueous solutions of 0.12 molar CdSO4, 0.88 molar ZnSO4 and 2 molar thiourea. Two drops of TEA and few drops of ammonium hydroxide were added to the bath to make the pH at10. All the

DAE Solid State Physics Symposium 2017
AIP Conf. Proc. 1942, 080080-1–080080-4; https://doi.org/10.1063/1.5028914
Published by AIP Publishing. 978-0-7354-1634-5/$30.00

PEG capped CaS nanoparticles synthesized by wet chemical co-precipitation method

S. Rekha, and E. I. Anila

Citation: AIP Conference Proceedings **1942**, 050039 (2018); doi: 10.1063/1.5028670
View online: https://doi.org/10.1063/1.5028670
View Table of Contents: http://aip.scitation.org/toc/apc/1942/1
Published by the American Institute of Physics

PEG Capped CaS Nanoparticles Synthesized by WetChemical Co-precipitation Method

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Abstract. Calcium sulfide (CaS) nanoparticles capped with polyethyleneglycol (PEG) were synthesized using wet chemical co-precipitation method. The structural and optical properties of the prepared sample were studied by X-ray diffractogram (XRD),transmission electron microscopy (TEM), diffuse reflectance spectrum (DRS) and photoluminescence (PL) spectrum.The structure of CaS nanoparticles is cubic as demonstrated by the X-ray powder diffraction (XRD) and selected area electron diffraction (SAED) analysis.TEMimage revealed the spherical morphology of the particles with diameter in the range 15-20 nm. The optical band gap of the prepared sample was determined from the DRS and its value was found to be 4.1 eV.The PL studies showed that the relative intensity of the PEG capped CaS nanoparticles was higher than that of uncapped CaS nanoparticles. The presence of various functional groups in the capped samples were examined by Fourier Transform Infrared (FTIR) spectroscopy.

INTRODUCTION

Alkaline earth sulfides which are sulfides ofthe group IIA alkali metals are excellent luminescent materials. Among the alkaline earth metal sulfides, Calcium sulfide (CaS) is the mostinvestigated material since 1971[1] because of its larger bandgap and wide range of emission wavelengthswhen doped with rare earth ions and transition metal ions. CaS is an excellent phosphor which has applications in cathode ray tubes, fluorescent lamps, TV screens and thermoluminescent dosimeters [2-6]. Recently efforts have been made by researchers to synthesize CaS phosphors in nanoform since they are cadmium free fluorescent nanomaterialsexhibiting novel electronic, structural and optical properties different from bulk materials which can be exploited in many optoelectronic devices [7,8].

Several methods have been employed for the synthesis of undoped CaS nanophosphors including solvothermal process, sol-gel method, chemical co-precipitation method and microwave synthesis.Wang et al. [9] prepared undoped CaS and SrS nanophosphors using solvothermal process. Yang et al. studied the luminescence of CaS nanocrystallites co-activated sol–gel derived silica xerogel prepared by sol-gel processing [10]. CaS nanoparticles were synthesized using wet chemical co-precipitation method byWu et al [11]. CaS nanoparticles have been synthesized by microwave irradiation, using$Ca(Ac)_2$ asCa-precursor, and thioacetamide as sulphur source by Roy et al [12].

In thepresent work we report the synthesis of uncapped and polyethyleneglycol (PEG) capped CaS nanoparticles using wet chemical co-precipitation method. The sampleswere characterizedusing X-ray Diffraction (XRD) pattern, Transmission Electron Microscopy (TEM), room temperature Photoluminescence (PL), UV-Vis Spectroscopy and Fourier transform infrared (FTIR) spectroscopy.

EXPERIMENTAL

PEG capped CaS nanophosphor was prepared by wet chemical co-precipitation method. The chemicals used were calcium chloride [$CaCl_2 .2H_2O$, 97% Merck] and sodium sulfide [$Na_2S . x H_2O$, 55% Nice chemicals]. 0.5 M $CaCl_2$ solution was prepared by dissolving suitable amount of $CaCl_2 .2H_2O$ in 50ml of 2-propanol. 50

DAE Solid State Physics Symposium 2017
AIP Conf. Proc. 1942, 050039-1–050039-4; https://doi.org/10.1063/1.5028670
Published by AIP Publishing. 978-0-7354-1634-5/$30.00

Tuning the surface morphology of aluminium doped zinc oxide thin films by arrayed nanorods through chemical growth process

Sebin Devasia, and E. I. Anila

Citation: AIP Conference Proceedings **1942**, 080018 (2018); doi: 10.1063/1.5028852
View online: https://doi.org/10.1063/1.5028852
View Table of Contents: http://aip.scitation.org/toc/apc/1942/1
Published by the American Institute of Physics

Tuning the Surface Morphology of Aluminium Doped Zinc oxide Thinfilms by Arrayed Nanorods Through Chemical Growth Process

Sebin Devasia[1] and E I Anila[1, a]

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Abstract. Here we report the growth and characterization of chemically grown aluminium doped zinc oxide nanorods on seed layers. The seed layers were prepared by chemical spray pyrolysis which acted as the growth centers. The growth duration of nanorods were varied from 3h to 12h in steps of 3h. Further, investigations on their structural, morphological, electrical and optical properties. The SEM images confirmed the hexagonal shaped nanorod arrays grown on the seed layers. Later, the x-ray diffraction measurements revealed the pure zinc oxide phase of the samples. Photoluminescence and photoconductivity studies were carried out to analyze the potential of its optoelectronic properties.

INTRODUCTION

Zinc oxide is considered to be the future of optoelectronics for its excellent semiconducting properties like wide band gap (3.36 eV), large exciton binding energy (60 meV) as well as good chemical and thermal stability [1]. Tremendous enhancement in the efficiency of various optoelectronic devices have been achieved through modifying the surface morphology of zinc oxide films. Nanostructured zinc oxide thin films have been used in self-cleaning applications [2], dye sensitized solar cells [3], LEDs [4], lasers diodes [5] and photodiodes [6].

EXPERIMENTAL

The seed layers were deposited by spraying the precursor solution, prepared by dissolving zinc acetate and aluminium acetyl acetonate (2 at.%) in a solvent mixture of propanol and water (7:3), onto glass substrates kept at a constant temperature of 450 ^{0}C.

Low temperature chemical growth process was followed for the growth of aligned nanorods on the surface of seed layers. For that the seed layers were dipped in a solution of 0.05 M hexamethylenetetramine (HMTA), $Zn(NO_3)_2$ and $AlCl_3$. HMTA or hexamine serves as a bidentate Lewis base that attaches Zn^{2+} ions and enhances the growth along the direction of polar surface [002]. Moreover, it prohibits the growth along non polar [001] direction leading to efficient nanorod growth [7]. Subsequently, the seed layer films were dipped face down in the solution kept at a constant temperature of 95 ^{0}C for 3 hours with changing the solution at equal intervals. Then the samples were washed with distilled water and afterwards kept in the same solution at a temperature of 50 ^{0}C for various growth durations of 3h, 6h, 9h and 12h. Finally, the as grown nanorods on the seed layers were cleaned with distilled water and propanol to remove remnants of solution and dried.

The X-ray diffraction, Scanning electron microscopy, Photoluminescence spectroscopy and conductivity measurements were employed to understand the effect of growth duration on the structural, morphological, optical and electrical properties of zinc oxide nanorods grown on the seed layer.

DAE Solid State Physics Symposium 2017
AIP Conf. Proc. 1942, 080018-1–080018-4; https://doi.org/10.1063/1.5028852
Published by AIP Publishing. 978-0-7354-1634-5/$30.00

Z-scan measurement for nonlinear absorption property of rGO/ZnO:Al thin film

V. G. Sreeja, and E. I. Anila

Citation: AIP Conference Proceedings **1942**, 080007 (2018); doi: 10.1063/1.5028841
View online: https://doi.org/10.1063/1.5028841
View Table of Contents: http://aip.scitation.org/toc/apc/1942/1
Published by the American Institute of Physics

Z-Scan Measurement for Nonlinear Absorption Property of rGO/ZnO:Al Thin Film

V G Sreeja[1] and E I Anila[1*]

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Abstract. We report the fabrication of reduced graphene oxide integrated aluminium doped zinc oxide (rGO/ZnO:Al) composite thin film on a glass substrate by spin coating technique. The effect of rGO on structural and linear optical properties of rGO/ZnO:Al composite thin film was explored with the help of X-Ray powder diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and UV-Vis absorption spectroscopy. Structural studies reveals that the composite film has hexagonal wurtzite structure with a strong bonding between rGO and ZnO:Al material. The band gap energy of ZnO:Al thin film was red shifted by the addition of rGO. The Nonlinear absorption property was investigated by open aperture Z-scan technique by using Q switched Nd-YAG laser at 532nm. The Z-scan results showed that the composite film demonstrates reverse saturable absorption property with a nonlinear absorption coefficient, β, of 12.75×10^{-7}m/w. The results showed that investigated rGO/ZnO:Al thin film is a promising material suitable for the applications in absorbing type optical devices such as optical limiters, optical switches and protection of the optical sensors in the field of nonlinear optics.

INTRODUCTION

Graphene is a promising two-dimensional, one atom thick nanomaterial which has motivated great interest in various fields of science and technology [1,2]. Since graphene has excellent optical, mechanical, thermal and electronic properties, it has been considered as a gifted element for many applications in optoelectronics and Photonics [1,2,3]. Reduced graphene oxide (rGO) contains a mixture of large π –conjugated sp^2 and sp^3– hybridized carbon atoms which shows remarkable nonlinear mechanisms like saturable absorption (SA), reverse saturable absorption (RSA), nonlinear scattering, etc [3, 4]. ZnO is a versatile wide band gap semiconductor material that has attracted nonlinear optical property. This makes them an idyllic candidate for potential nonlinear optical devices [5]. Aluminium doped ZnO material is a crucial component for many optoelectronic and nonlinear optical devices because of its high transparency to visible light and nonlinear optical property [6]. The excellent properties of their nanocomposites has been widely recognized and used for the fabrication of optical devices because of its light weight, better stability, good optical transparency, high optical nonlinearity and polarisability [5,6]. The investigated rGO/ZnO:Al composite thin film is showing excellent nonlinear absorption property. This is expected to explore potential applications in nonlinear optics such as optical limiters, sensors and can be utilized for protecting delicate optical instruments, human eye from intense laser pulses [3, 4, 5, 6].

In the present research work, we report the nonlinear absorption property of rGO/ZnO:Al composite thin film synthesized by spin coating technique. The film was further investigated for their structural and optical properties and the mechanism behind the nonlinear absorption properties of the film, according to the perspective of our observations is also reported. However to the best of our knowledge no systematic study has been reported on the effect of addition of rGO on nonlinear optical properties of ZnO:Al composite thin film by spin coating method.

MATERIALS AND METHODS

In the present investigation, the rGO/ZnO:Al thin film was deposited on properly cleaned glass substrates by spin coating technique. The precursor solution used was of 0.1 M concentration of high purity zinc acetate dehydrate

DAE Solid State Physics Symposium 2017
AIP Conf. Proc. 1942, 080007-1–080007-4; https://doi.org/10.1063/1.5028841
Published by AIP Publishing. 978-0-7354-1634-5/$30.00

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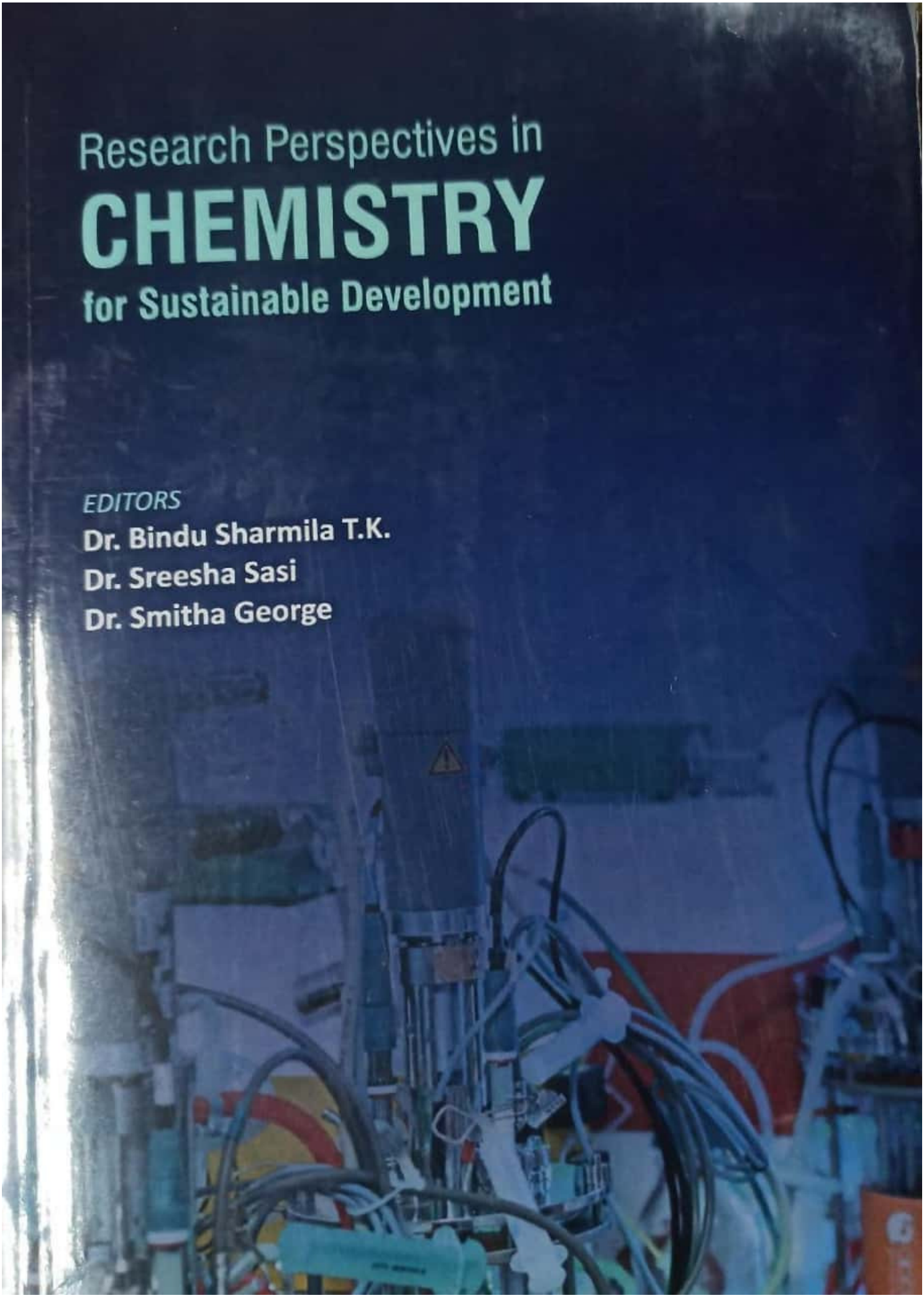

First Impression: February 2020

Research Perspectives in Chemistry for Sustainable Development

ISBN: 978-93-89947-01-4

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Chapter 16

Effect of Electrolyte Bath Temperature on the Fabrication and Characterization of Iron Oxide Nanostructures

Julie Ann Joseph[1], Sinitha B. Nair[2], Hilal Rahman[3] and Rachel Reena Philip[4]

Abstract: *In the present work, maghemite nanostructures are prepared by a simple and cost effective method of anodization using iron foil as anode and titanium foil as cathode in an electrolyte containing ammonium fluoride and deionised water in ethylene glycol solution. Here, we have attempted to study the effect of electrolyte bath temperature on the fabrication of iron oxide nanostructures. The electrolyte bath temperature is varied as 12°C, 27°C and 40°C by keeping all the other deposition parameters constant. The structural, morphological, optical and electrical characterizations are performed. The study reveals that tuning of band gaps and morphology are possible in iron oxide nanostructures by varying the electrolyte bath temperature.*

Keyword: *Nanostructures, Maghemite, Anodization, Bath Temperature*

1. Introduction

Iron oxide nanostructures are good candidates for device applications due to their stability, higher surface to volume ratio and optimal band gap. Hematite (α-Fe_2O_3), magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) are the major phases of iron oxide. Maghemite (γ-Fe_2O_3) is one of the stable iron oxide polymorph available and is extensively studied due to their properties such as thermal and chemical stability, non-toxicity, biocompatibility and favourable magnetic properties [1]. They have attracted much interest due to their potential applications in magnetic storage media, magnetic resonance imaging, gas sensors, photocatalysis and biomedical applications [2-6].

A number of methods can be used to prepare maghemite nanostructures such as sol gel[7], microemulsion [1] and ball milling techniques [8]. Among these methods, anodization is a simple and cost effective method for the fabrication of maghemite nanostructures. This technique can be utilized to vary the growth

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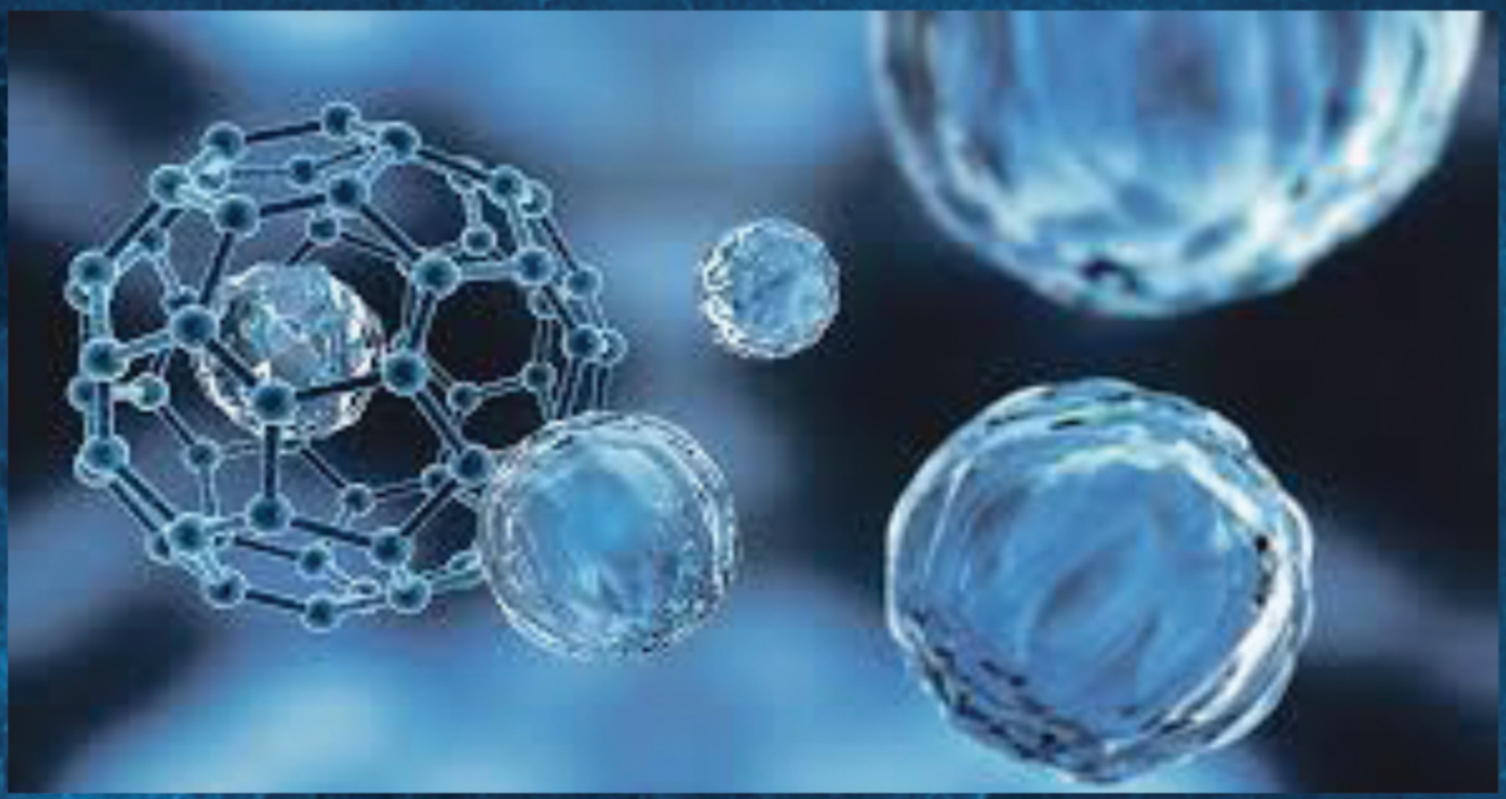

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Al-Ameen College,
Edathala, Aluva, Ernakulam (Dist.), Kerala, India.

Pincode - 683 564.

Title of Book:

Proceedings of National Seminar on Nanomaterials-Synthesis and Characterisation

ISBN:

9 789353 460655

Published by Physics Department, Al-Ameen College, Edathala, Aluva

Ernakulam (Dist.), Kerala, India. Pincode - 683 564.

Printed by Al- Ameen printers

Properties of transparent conducting SnO_2 thin films by chemical spray pyrolysis method

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Optoelectronic and Nanomaterials' Research Laboratory, Department of Physics, Union Christian College, Aluva-683102,Kerala,India
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Abstract: Nanostructured SnO_2 thin films for 0.05M, 0.15M, 0.2M, 0.3M were prepared by chemical spray pyrolysis method on a glass substrate and their structural, optical and electrical properties were investigated. X-ray diffraction (XRD) studies show polycrystalline nature of the films with orthorhombic crystal structure. The average grain size was calculated by Scherrer's formula are 16 nm to 21 nm respectively for the samples. Scanning electron microscopic (SEM) image of the thin film shows small granular grains distributed throughout the surface revealing a smooth and homogeneous surface morphology. The optical band gap of SnO_2 thin films are 3.26 eV to 3.75 eV respectively for different molarities. PL spectrum of the sample shows two broad emissions which covers Near band edge emission (NBE) as well as deep level emission (DLE) in the region 380nm-620nm.

Keywords: Thin film, spray pyrolysis, orthorhombic, near band edge emission, deep level emission.

I. INTRODUCTION

Tin Oxide (SnO_2) belongs to the II-VI family of n-type semiconducting material with tetragonal rutile structure having a wide band gap of 3.6 eV-4eV [1,2]. The study of SnO_2 transparent conducting oxide thin films are of great interest due to good electrical, high optical transmittance, low resistivity, good piezoelectric behavior, non toxicity, uniformity, stability to heat treatment, better mechanical hardness, and its low cost [3-5]. SnO_2 has wide range of applications such as gas sensor devices [6], in transistors [7], window material for solar cells [8], optoelectronic devices [9] etc. SnO_2 thin films have been prepared by various techniques such as sol-gel method [10], chemical bath deposition [11], SILAR [12], electron beam evaporation [13], pulsed laser deposition [14], sputtering [15], spray pyrolysis [16] etc. In the present study, we have investigated the optical, structural and electrical properties of SnO_2 thin films, grown by spray pyrolysis technique because of its simplicity and low cost.

II. EXPERIMENTAL DETAILS

An amount of required grams of $SnCl_2.2H_2O$ was dissolved in distilled water to make 0.05M and 0.15M, 0.2M and 0.3M concentration of precursor solutions and a few drops of concentrated hydrochloric acid was added to make the solution transparent. Then the mixture was magnetically stirred at 60^0C for an hour. Ultrasonically cleaned substrates were then placed on the substrate heater of the spray equipment to provide proper heating with uniformity to films. Spraying was done at

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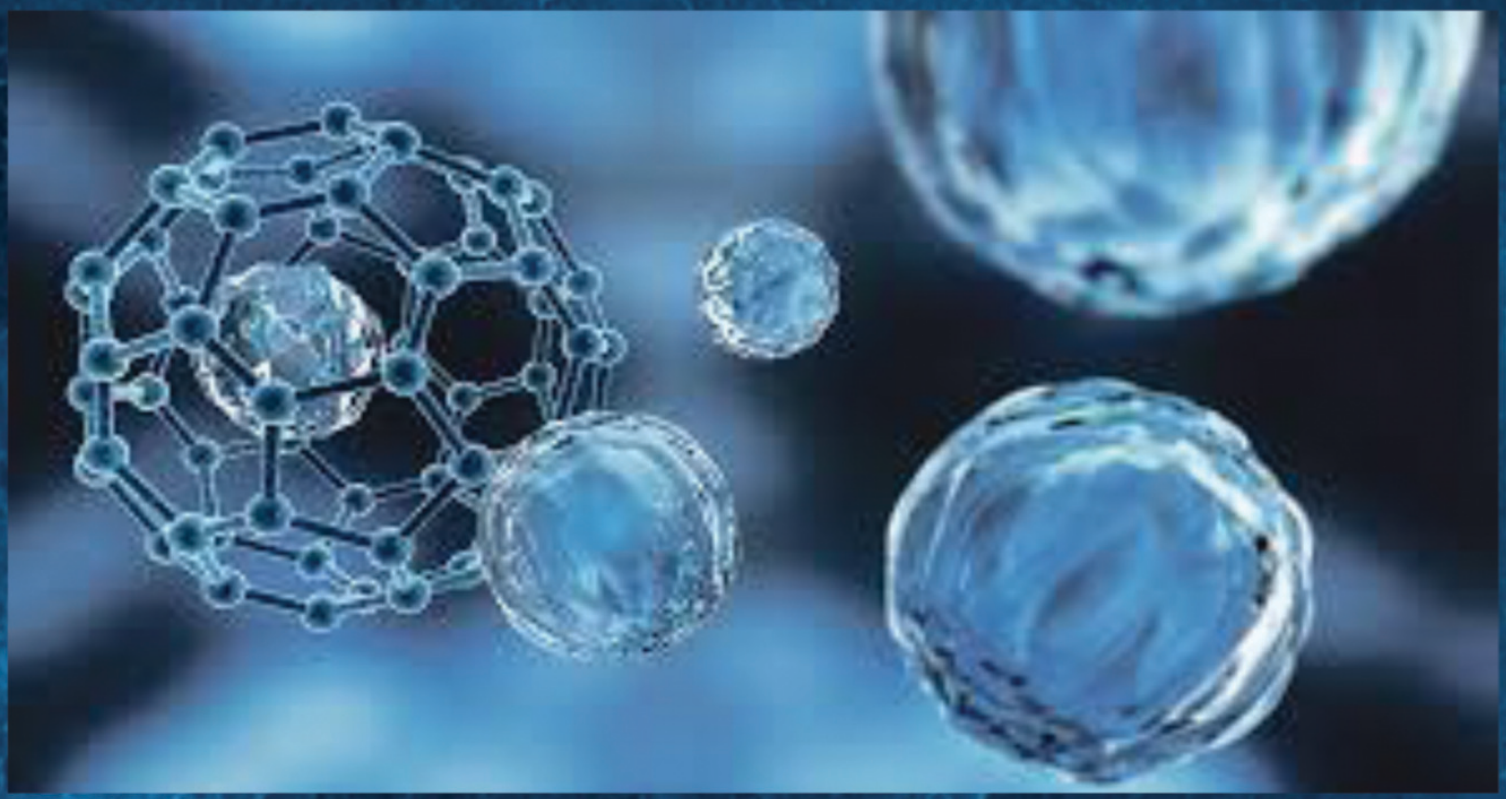

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Pincode - 683 564.

Title of Book:

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ISBN:

9 789353 460655

Published by Physics Department, Al-Ameen College, Edathala, Aluva

Ernakulam (Dist.), Kerala, India. Pincode - 683 564.

Printed by Al- Ameen printers

Fluorescence Resonant Energy Transfer between ZnO Nanoparticles and Fluorescein Dye in Liquid Medium

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Abstract: This paper reports the Fluorescence Resonant Energy Transfer (FRET) mechanism observed in fluorescein dye doped ZnO nano composite which is due to the electron transfer between the acceptor and the donor. This results in the fluorescence quenching of the donor. During FRET the energy transfer between the donor and acceptor takes place non radiatively. This result is of great use in the quantitative analysis of molecular dynamics in biophysics and microbiology. We have observed a FRET efficiency as high as 76% in the studied composite by varying the doping level of ZnO nano particles with Fluorescein dye. The observed results are explained using the electron transfer protocol between the two species.

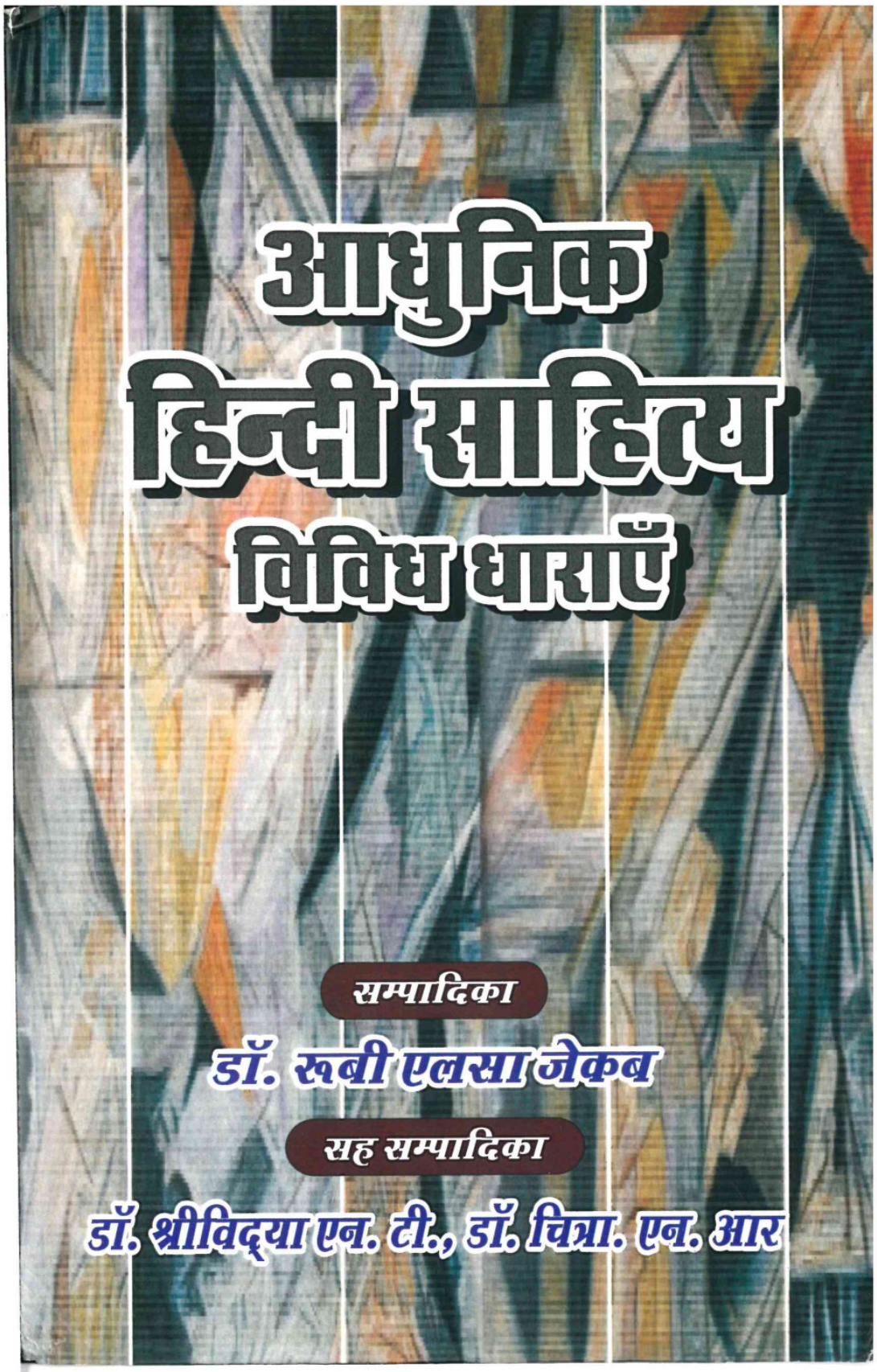
Keywords-FRET Dye, ZnO Nano particle

I. INTRODUCTION

Fluorescence Resonant Energy Transfer (FRET) is an important non radiative electro dynamical phenomenon having wide range of applications including bio imaging, development of optoelectronic devices, dye lasers and thin film devices and so on. Biosensors based on FRET open a cost effective and user friendly method in medical sciences [1]. FRET also helps us to understand how molecular interactions occur at the nanometer range. It reveals structural information regarding the donor – acceptor pair [2].Low-dimensional structure of semi-conductor materials such as rods, nano particles (NP), nano wires etc. have attracted much interest because of their unique structural, physical and chemical properties and they are therefore used as the building blocks in electronics and optoelectronics devices [3].

Many researches on FRET of two different dye molecules are reported but of late the interaction between nano particles and dyes have gained significance as the light matter interaction can be modified by positioning the nano particles in the vicinity of dyes [4]. ZnO NP are of particular interest due to their biocompatibility, less toxicity and very high chemical stability and they are already used in medical diagnostics [5]. The Fluorescein iosthiocynate (FITC) encapsulated multifunctional ZnO nano composite can be used as smart nanostructures for cell imaging and cancer therapy [6].

Researchers are still developing the metal–enhanced fluorescence wherein the spatial control of these nano emitters can be used to manipulate the excitonic interaction among the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विद्या प्रकाशन
सी, 449, गुजैनी, कानपुर - 22

ISBN : 978-93-86248-59-6

पुस्तक	:	आधुनिक हिन्दी साहित्य विविध धाराएँ
लेखिका	:	डॉ. रूबी ऐलसा जेकब, डॉ. श्रीविद्या. एन.टी. डॉ. चित्रा. एन.आर.
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संस्करण	:	प्रथम 2018
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'एक ज़मीन अपनी' में चित्रित महानगरीय जीवन

आन्सी. एम

महानगर एक विशाल विस्तृत क्षेत्र है जहाँ आदमी अधिक आबादी से अपने परिमित वातावरण में परिवार के साथ रहते हैं । यहाँ का विकास तीव्र गति हो रहा है । इस शहरीकरण की प्रक्रिया में बहु भाषियों, प्रचारियों तथा व्यापारियों ने अपना स्थान निभाती है । भारत के प्रमुख महानगरों में एक है मुंबई । अरब सागर से ज़रा ऊँचा और भारत के पश्चिमी तट पर कोंकण तटीय क्षेत्र में उलहास नदी मुहाने पर स्थित है । भारतीय चलचित्र का जन्मस्थान है मुम्बई । फिल्मी दुनिया के लोग मुम्बई महानगर को प्यार से बॉलिवुड कहते हैं । इस बॉलिवुड में आदमी की ज़िन्दगी से कोई मतलब नहीं है । क्योंकि आज का साधारण मर्द कल का हीरो होगा । यहाँ नाम, काम, पैसा सब क्षणिक है । भारत के अधिक तथा दुनिया का पाँचवाँ आबादीवाला शहर है मुम्बई ।

मुम्बई महानगर का केन्द्र में रखकर लिखा गया चित्रा मुद्गल के प्रमुख उपन्यास है 'एक ज़मीन अपनी'। विज्ञापन जगत के एक खास चुने हुए कथ्य और परिवेश के माध्यम से आधुनिक नारी की सच्ची अस्मिता, व्यक्ति के रूप में उसकी सार्थक और वास्तविक परिस्थिति के तलाश की अभिव्यक्ति हुई है । उन्होंने जिन्दगी के विभिन्न समस्याओं को बहुत सुन्दर ढंग से प्रस्तुत किया है ।

महानगर की आधुनिकता –महानगर में आधुनिकता से भौतिक जीवन और चिंतन पिछली सदी से पर्याप्त रूप से भिन्न होते जा रहा हैं । 'एक ज़मीन अपनी' विज्ञापन की दौर में रहने वालों के संघर्ष की कहानी है। उपन्यास इन संघर्षों को तन्मय भाव से प्रस्तुत करता है । पाश्चात्य सभ्यता और संस्कृतियों के अन्धानुकरण करके अंग्रेज़ी भाषा को अधिक महत्व देते है । औरतें अपने मर्द साथियों के साथ होटल में धूमती है । रात में पार्टियों में जाती है । बिना शंका से यौन शोषण करते है । बिना ब्याह करके एक दूसरे के साथ रहती है । किसी को

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South Indian History Congress
First Published : January 2019

Website: www.southindianhistorycongress.org

The publication of the proceedings was financially supported by Indian Council of Historical Research, New Delhi and the responsibility of the facts stated, opinions expressed and conclusions reached is entirely that of author/authors of the articles and the Indian Council of Historical Research accepts no responsibility for them

Printed at

M/s. Sathiyam Printers
4929, TNHB, Thendral Nagar,
Villapuram, Madurai - 625 011
Phone: 0452-4369617, 9715675617

ISSN 2229-3671

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REFLECTING ON PANAMPILLY GOVINDA MENON THROUGH HIS ARTICLES

Dr. Twincy Varghese

Panampilly Govinda Menon, a resourceful leader of masses, freedom fighter, dedicated political personality who used all chances to serve his society, an administrator who served his state as well as his nation at various levels, a social activist who tried to strengthen his people through education and empowerment, a diplomat who upheld the glory of his mother country at different international platforms also proved to be a man of letters through several articles and critiques. Besides being a politician, and a Parliamentarian, Govinda Menon was a person with diversified talents. He was a prolific reader, an extra ordinary orator and a known writer. He was an active worker of the Granthasala prasthanam of Kerala which played a vital role in making the state high in literacy.

Born on 1st October 1906 at Kakkadu near Chalakkudy Trissur district, Panampilly was a lawyer by profession[1] Profound reading, unusual orating skills and deep love and concern towards his state as well as nation took him to the level of a political worker at a young age itself. Being a member of the Cochin Legislative Council since 1935 till the formation of Thiru-Kochi Menon wholeheartedly initiated and participated in the growth of democratic government in

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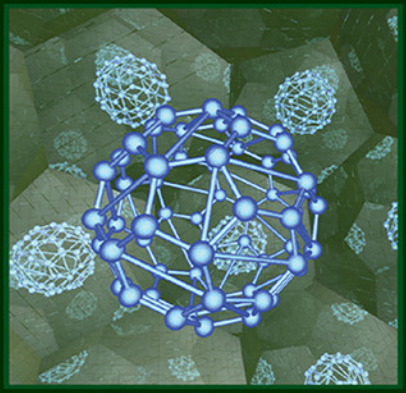

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Porous tantalum: A new biomaterial in orthopedic surgery

11

Neena George[1] *and Ajalesh B. Nair*[2]
[1]Post Graduate and Research Department of Chemistry, Maharaja's College, Ernakulam, Kerala, India, [2]Department of Chemistry, Union Christian College, Aluva, Kerala, India

Abstract

Porous tantalum has become an attractive biomaterial in several orthopedic applications due to excellent biocompatibility and biomaterial properties. This transition metal has high volumetric porosity (75%−80%), high coefficient of friction, and low modulus of elasticity (3 MPa) comparable to cancellous bone or subchondral bone. The tantalum has similar appearance to cancellous bone and is safe to use in vivo as evidenced by the use in orthopedic surgery. Currently tantalum has been used in several clinical orthopedic applications including hip and knee arthoplasty, spine fusion, osteonecrosis, cranioplasty, foot and ankle surgery, and tumor reconstructive surgery. Porous tantalum has the ability to form a self-passivating surface oxide layer which leads to the formation of a bone-like apatite coating in vivo and affords excellent bone and fibrous in-growth properties allowing for rapid and substantial bone and soft tissue attachment. The chapter discusses the biomaterial properties and orthopedic applications of porous tantalum.

Keywords: Porous tantalum; orthopedic surgery; biomaterial; biocompatibility

11.1 Introduction

The term bone defect refers to the bone loss caused by infection, bone trauma, tumor resection, and other diseases [1]. Large area bone defects cannot be regenerated and repaired by the body [2]. One of the complex issues encountered by orthopedic reconstructive surgeons is to find an appropriate material that is well tolerated by bone tissue. Grafts taken from the patient himself act as the best bone replacement materials. These replacements, known as autologous bone grafting are found to be biocompatible, osteoconductive, and osteoinductive, and moreover there is no danger of immuno-rejection. But this procedure has limitations in the case of large area bone defects because of the limit on the amount of autograft available for each patient and the extraction causes additional trauma [3,4]. If allografts derived from donators or xenografts from animal tissue are used instead, there is an additional risk of immuno-rejection and disease transmission [5]. Allogeneic and autologous bone grafting are also limited by their inability to

Fundamental Biomaterials: Metals. DOI: https://doi.org/10.1016/B978-0-08-102205-4.00011-8