Journal of Non-Crystalline Solids 597 (2022) 121893

Contents lists available at ScienceDirect

Journal of Non-Crystalline Solids

journal homepage: www.elsevier.com/locate/jnoncrysol

Effect of Ag_2S on electrical conductivity and dielectric relaxation in Ag_2O-MoO_3-P_2O_5 ionic glassy systems

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ARTICLE INFO

Keywords:
Ionic conduction
Almond-West formalism
Dielectric permittivity
Complex dielectric modulus
Conductivity relaxation process

ABSTRACT

The influence of Ag_2S incorporation on the electrical and dielectric properties of the host Ag_2O-MoO_3-P_2O_5 glassy matrix has been systematically studied in the present communication. By applying the well-known Archimedes principle, the density of the samples has been determined. The ionic property for all the as-prepared glassy systems has been explored methodically. The nearly identical obtained values of the crossover frequency and the activation energy for DC and AC conductivity suggest that the same mechanism is responsible for electrical conduction. For the purpose of inspecting the frequency and temperature dependent AC conductivity, the Almond-West formalism model has been used. The observed values of dielectric constant and dielectric loss are found to increase with the temperature rise and drop with rising frequency. The coinciding scaled complex electric modulus spectra suggest a non-Debye type dynamical relaxation mechanism, which also indicates that the relaxation mechanism is temperature independent but composition dependent.

1. Introduction

The ion conducting glassy systems have been researched for decades owing to their significant role in electrochemical applications, including solid-state batteries, which have an ever-increasing demand for more energy-dense, eco-friendly, cost-effective electrolytes and electrode materials [1–4]. It is reported that silver ion conducting glasses doped with silver halides exhibits extraordinarily high silver ion mobility, making them potential candidates for solid electrolytes, memory devices and optical switches [5]. The study of the transport mechanism of a few Ag_2S-based glass nanocomposites shows that the conduction mechanism is influenced by the microscopic structure of the glass matrices. In such ionic glasses, the conductivity is modified due to the formation of Ag_2S nanocrystallites within the matrix, indicating a strong composition dependency [6]. The glass network can be modified using glass modifier oxides like Li_2O or Ag_2O or doped with dopants like silver halides or alkali halides, among other methods, to enhance ionic conductivity [3,4]. Glass matrices depolymerize as a result of the inclusion of glass modifier oxides, increasing the concentration of non-bridging oxygen ions that increases the number of hopping sites for the mobile ions, enhancing the system's ionic conductivity [7]. The use of phosphate oxide glass systems in many domains like low-temperature sealing applications, energy converters, optical communication, photonic devices, and biomedical applications have developed the interest of researchers [2]. Due to the higher ionic conductivity and electrochromism properties of phosphate-molybdenum glass systems, it is used in the

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https://doi.org/10.1016/j.jnoncrysol.2022.121893
Received 27 June 2022; Received in revised form 8 August 2022; Accepted 28 August 2022

Journal of Physics and Chemistry of Solids 180 (2023) 111462

Contents lists available at ScienceDirect

Journal of Physics and Chemistry of Solids

journal homepage: www.elsevier.com/locate/jpcs

Defects characteristic investigation of bismuth ferrite nanocrystallites through positron annihilation and supportive methods

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ARTICLE INFO

Keywords:
Bismuth ferrite
Defects
Electron microscopy
Multiferroics
Nanocrystallites
Optical absorption
Positron annihilation

ABSTRACT

Phase pure bismuth ferrite (BFO) nanocrystallites were synthesized by sol-gel method. The variation in the time of calcination at 600 °C is used as the parameter to vary the sizes of the nanocrystallites. X-ray diffraction and electron microscopic studies revealed the formation of BFO nanocrystallites of well-defined sizes and morphology. The elemental stoichiometric compositions of the samples were verified using energy dispersive analysis of X-rays and further by X-ray photoelectron spectroscopy. The UV–visible diffuse reflectance spectra showed strong absorption at the wavelength ~556 nm (2.23 eV) for BFO nanocrystallites of dimensions 20 nm. For nanocrystallites of sizes smaller than this limit, the band gap energies showed remarkable increase due to the onset of quantum confinement effects. The band gap energies showed increase at larger crystallites sizes as well, indicating defects formation due to oxygen deficiencies. Positron annihilation spectroscopy is used to characterize and monitor the defects. The formation of Bi^{3+}-O^{2-} divacancies significantly altered the positron annihilation characteristics at larger crystallite sizes.

1. Introduction

In recent times, there have been several attempts to combine different physical properties in a single material. The effort has been more prominent in multiferroics because of the dual existence of the apparently distinct ferroelectric and ferromagnetic properties in them. Amidst the multiferroics, bismuth ferrite ($BiFeO_3$; also commonly referred to as BFO) has been a promising material because of its unique crystal structure and multiferroic properties. There has been great curiosity to explore the aforesaid features in this material because of its capability of handling strong magnetic fields and high electric currents. Apart from the interesting fundamental physical properties, BFO finds a wide range of potential applications from the technological perspective due to their magnetoelectric coupling effects [1–5]. Moreover, BFO is the only compound known to exhibit simultaneous ferroelectric and G-type antiferromagnetic behaviour over an appreciable range above room temperature. The ferroelectric transition Curie temperature (T_C) and the antiferromagnetic Néel temperature (T_N) are 1103 K and 643 K respectively [5,6]. BFO exhibits a rhombohedrally distorted ABO_3 perovskite structure with space group *R*3*c* [7].

Recently there has been more focus on substrate-free low-dimensional nanostructures [8–13]. Nanostructures facilitate high surface area and also generate active sites for reactions. An important consequence is the prominent visible-light photocatalytic activity of BFO nanoparticles [14]. A number of studies on the finite size effects on BFO have reported interesting results like shifting of the Néel temperature and ability of gas sensing [14–18]. There are also reports on the strengthening of the multiferroic properties at smaller crystallite sizes [19,20]. In particular, the synthesis of BFO nanoparticles (NPs) with good phase purity offers great potential towards the improvement of the physical properties. Moreover, it widens the potential applications of BFO in various fields of science and technology.

Owing to the requirement of nanocrystalline sizes and also due to the volatile nature of bismuth, a low-temperature synthesis route is always preferred. The various wet chemical methods at low temperatures are those based on co-precipitation, sonochemical process, solution-

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https://doi.org/10.1016/j.jpcs.2023.111462
Received 3 March 2023; Received in revised form 5 May 2023; Accepted 22 May 2023
Available online 22 May 2023

Journal of Non-Crystalline Solids 609 (2023) 122235

Contents lists available at ScienceDirect

Journal of Non-Crystalline Solids

journal homepage: www.elsevier.com/locate/jnoncrysol

Effect of transition metal and alkali oxides on structural, optical and dielectric properties in Zinc-Phosphate amorphous glassy systems

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ARTICLE INFO

Keywords:
Rietveld refinement
Optical band gap
Refractive index
Dielectric properties
Havriliak-negami formalism
Complex electric modulus

ABSTRACT

The influence of transition metal and alkali earth metal oxide on the structural, optical and dielectric properties of inorganic glasses prepared by melt quenching method, having chemical composition $0.35ZnO—0.25P_2O_5$-$(0.4\text{-}x)$ Na_2O-xV_2O_5 ($0.05 \leq x \leq 0.25$), have been studied. The Rietveld Refinement of the XRD spectra confirms the presence of $Na_3P_8VO_{23}$ and $Zn_2V_2O_7$ nanocrystallites. Raman spectroscopy has been deployed to identify and quantify the individual phases present within the glass matrix. The optical bandgap energy values, which are obtained from the UV–Vis spectra, vary with V_2O_5 concentration (x), and an inverse association between the optical bandgap and Urbach energy has been demonstrated. The absorbance and reflectance spectra have been investigated, and several optical parameters, such as the excitation and absorption coefficients, refraction index, polarizability, SELF and VELF functions, etc., have also been examined. The dielectric constant and dielectric loss decrease with the increase in frequency but increase with the rising temperature. The dielectric properties have been examined at various temperatures and frequencies. The analysis of the scaling property of electric modulus indicates the conductivity or dielectric relaxation mechanisms, which is temperature independent and composition-dependent. The estimated value of the exponent parameter from Bergman's function being less than unity confirms the non-Debye type relaxation process occurring within the transition metal and alkali oxide doped zinc-phosphate glass matrix.

1. Introduction

Phosphate glasses are significant materials in both technology and science because they have some remarkable physical properties, such as lower glass transition and melting temperatures, higher coefficients of thermal expansion, and high electrical conduction at low temperatures [1,2]. They are suitable candidates for producing faster ion-conducting materials, energy converters, laser hosts, glass-to-metal sealing, opto-electronic devices, and biocompatible materials because of their properties, as mentioned above [2,3]. On the other hand, these glasses have moderately low chemical stability frequently limits their applicability [4]. The inclusion of the glass network intermediate, ZnO, generates various Zn–O–P links, enhancing the chemical durability of alkali and alkaline earth phosphate glasses [5].

The zinc-phosphate glassy system is fascinating because it is reasonably simple to produce glasses with different ZnO levels that are higher than the compositional limit of pyrophosphate. When [Zn]/[P] = 1, these glasses exhibit phosphate structures that are considerably depolymerized with an average of three non-bridging oxygens per tetrahedron [6]. Zinc polyphosphate glasses are more resilient, have low glass transition temperatures (T_g), and have a wider range of glass-forming compositions as compared to different prevalent

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https://doi.org/10.1016/j.jnoncrysol.2023.122235
Received 15 December 2022; Received in revised form 15 February 2023; Accepted 17 February 2023

J Mater Sci: Mater Electron (2023)34:528

Effect of incorporation of alkali earth metal oxide on structural, optical and DC conduction mechanism in tellurium-phosphate glassy systems

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Received: 12 November 2022
Accepted: 21 January 2023

ABSTRACT

The influence of alkali earth metal oxide on the structural, optical and electrical properties of inorganic glasses having chemical composition xCaO–(0.35-x) BaO–0.40TeO_2–0.25P_2O_5 (x = 0.0, 0.05, 0.1, 0.15, 0.20, 0.25, and 0.35) were studied and prepared by melt-quenching method. With an increase in CaO concentration (x), it was found that physical characteristics like density (4.5 to 3.9 g cm^{-3}) and oxygen packing density (57.2 to 59.8 mol-$litre^{-1}$) decreased and increased, respectively. The Rietveld refinement process was used to analyse the x = 0.0 and x = 0.25 samples, revealing peaks were primarily due to the hexagonal $Ba_2P_2O_7$ and tetragonal TeO_2 phases, respectively. The Te–O bond of the TeO_4 tetrahedral unit, Te–O–Te linkage, and PO_3^{2-} groups inside the glass matrix were among the several bond configurations that were identified using Raman spectroscopy. The value of the optical bandgap energy reduced with the inclusion of CaO up to sample x = 0.15, after which it was found to increase and Urbach energy, on the other hand, followed the opposite trend. The absorbance and reflectance spectra were studied and different optical parameters like absorption coefficient, extinction coefficient, reflectivity, refraction index, polarizability, etc., were studied and discussed. The determined values of third-order optical susceptibility and non-linear refractive index suggested potential optoelectronic applications because it was observed that they increased up to x = 0.15 sample before reducing once more. The DC conductivity value ranged

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https://doi.org/10.1007/s10854-023-09958-8

sensors

MDPI

Article

Squeeze Film Effect in Surface Micromachined Nano Ultrasonic Sensor for Different Diaphragm Displacement Profiles

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Abstract: In the present paper, we have analytically explored the small variations of the local pressure in the trapped air film of both sides of the clamped circular capacitive micromachined ultrasonic transducer (CMUT), which consists of a thin movable membrane of silicon nitride (Si_3N_4). This time-independent pressure profile has been investigated thoroughly by solving the associated linear Reynold's equation in the framework of three analytical models, viz. membrane model, plate model, and non-local plate model. The solution involves Bessel functions of the first kind. The Landau–Lifschitz fringing technique has been assimilated to engrave the edge effects in estimation of the capacitance of CMUT, which should be considered in the micrometer or lesser dimension. To divulge the dimension-based efficacy of the considered analytical models, various statistical methods have been employed. Our use of contour plots of absolute quadratic deviation revealed a very satisfactory solution in this direction. Though the analytical expression of the pressure profile is very cumbersome in various models, the analysis of these outputs exhibits that the pressure profile follows the displacement profile in all the cases indicating no viscous damping. A finite element model (FEM) has been used to validate the systematic analyses of displacement profiles for several radii and thicknesses of the CMUT's diaphragm. The FEM result is further corroborated by published experimental results bearing excellent outcome.

Keywords: CMUT; Reynold's equation; displacement profile; pressure profile; modified Bessel's equation; FEM

Citation: Dastidar, A.G.; Maity, R.; Tiwari, R.C.; Vidojevic, D.; Kevkic, T.S.; Nikolic, V.; Das, S.; Maity, N.P. Squeeze Film Effect in Surface Micromachined Nano Ultrasonic Sensor for Different Diaphragm Displacement Profiles. *Sensors* **2023**, *23*, 4665. https://doi.org/10.3390/s23104665

Academic Editors: Junhui Hu and Ming Yang

Received: 2 April 2023
Revised: 5 May 2023
Accepted: 7 May 2023
Published: 11 May 2023

1. Introduction

Nowadays, pressure sensors play an important role in different fields of applications [1–3]. Conventional bulk-piezo transducer is a common pressure sensor, though it has some disadvantages over CMUT, such as geometry constraint for choice of frequency, failure in high temperatures, and non-preference for operation in air (due to high impedance mismatch between piezoelectric material and air) [4]. On the other hand, the cost-effective applications of CMUT in the field of non-destructive testing and evaluation (NDE) [5–9], have the precedence over piezoelectric transducers in different aspects (e.g., superior bandwidth, facile batch fabrication, better interfacing capability, suitability for air-coupled non-destructive applications) [10,11], and thus inspires the investigation of its appropriate design before fabrication.

Microsystem Technologies (2023) 29:583–597
https://doi.org/10.1007/s00542-023-05412-1

TECHNICAL PAPER

An efficient electrostatic actuation model for MEMS-based ultrasonic transducers with fringing effect

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Received: 30 March 2022 / Accepted: 3 January 2023 / Published online: 27 January 2023

Abstract
In this paper an improved analytical model of electrostatic force for capacitive micromachined ultrasonic transducer (CMUT) has been carried out. These findings are consistent with Landau's method for CMUT fringing field capacitance modeling. The behavior of electrostatic force is investigated for parameters such as the top electrode's diameter, gap separation, actuation layer thickness, and bias applied to CMUT. Due to a significant degree of force creation, a CMUT cell having silicon carbide (SiC) as actuation material is capable of generating high power ultrasonic waves, with approximately 20% improvement over a silicon nitride (Si_3N_4) counterpart. Introducing an insulation layer in the capacitive cell improves sensitivity and enhances device safety to operate at higher voltages and temperatures. For various insulating thicknesses, a detailed study has been carried out for isolation. The findings of the investigation using the finite element technique (FEM) and the suggested analytical model accord well. The results are also further corroborated by published experimental results.

1 Introduction

The main reason for the application arena of capacitive transducers as electrostatic actuators is its capability to drive in a comparatively higher electric field than that of piezoelectric transducers. To sustain reproducibility and accuracy, control should be managed throughout the operating condition with a high electric field (Huang et al. 2003). The device outperforms piezoelectric and magnetostrictive transducers due to its excellent mechanical impedance matching with the surrounding medium. Various research publications cover hexagonal, square, and circular elements based on the structural layer shape have been carried out. The hexagonal transducer is one of these designs that can work in wide temperature range and is relatively inexpensive to manufacture. The round shape is commonly recognized for obtaining a better measuring value of distance in an underwater application and also the repeatability of system. Furthermore, this structure has great sensitivity when used in medical imaging.

This study focuses on a circularly constructed cell and in many research articles (Ladabaum et al. 1998; Maity et al. 2020a, 2021a; Caronti et al. 2002; Lohfink and Eccardt 2005) detail descriptions of the device is explained with analytical models. The parallel plate capacitive action was used as an approximation in these experiments. Later, the CMUT parameters determined from the corresponding device model were used to calculate the exact displacement of the deflected top electrode (Nikoozadeh et al. 2004; Koymen et al. 2012). The top electrode was treated as a plate in these works, and the effect of non-uniform load was taken into account. Galerkin approach was used to solve the electrostatic action on an implemented plate (Ahmad and Pratap 2010). As the bias is increased, the top electrode experiences a non-uniform load distribution, which leads to a change in electrostatic force as their spacing fluctuates.

One of the foremost obstacles to commercialization of CMUT is the dielectric indicting difficulties, which has a substantial impact on the device's usual operation. The

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energies

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Article

Impact of Spotted Hyena Optimized Cascade Controller in Load Frequency Control of Wave-Solar-Double Compensated Capacitive Energy Storage Based Interconnected Power System

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Abstract: The concept of automatic generation control has an immense role in providing quality power in an interconnected system. To obtain quality power by controlling the oscillations of frequency and tie-line power, a proper controller design is necessary. So, an innovative endeavor has been undertaken to enforce a two-stage controller with the amalgamation of a proportional-derivative with filter (PDN) (integer-order) and a fractional order integral-derivative (FOID), i.e., PDN(FOID). In an effort to acquire the controller's gains and parameters, a bio-inspired meta-heuristic spotted hyena optimizer is applied. Various examinations manifest the excellence of PDN(FOID) over other controllers such as integral, proportional–integral, proportional–integral-derivative filter, and fractional order PID from perspectives concerning the diminished amount of peak anomaly oscillations, and the instant of settling for a three-area system. The system includes thermal–bio-diesel in area-1; a thermal–geothermal power plant in area-2; and a thermal–split-shaft gas turbine in area-3. It is also observed that the presence of renewable sources such as wave power plants and photovoltaics makes the system significantly better compared to the base system, when assessed individually or both together. Action in a combination of capacitive energy storage with duple compensation is also examined using the PDN(FOID) controller, which provides a noteworthy outcome in dynamic performance. Moreover, PDN(FOID) parameter values at a nominal condition are appropriate for the random patterns of disturbance needed for optimization.

Keywords: Archimedes wave energy conversion; automatic generation control; bio-diesel plant; capacitive energy storage; geothermal power plant; PDN(FOID) controller; PV; spotted hyena optimizer; wave power plant

Citation: Saha, A.; Dash, P.; Babu, N.R.; Chiranjeevi, T.; Venkateswararao, B.; Knypiński, Ł. Impact of Spotted Hyena Optimized Cascade Controller in Load Frequency Control of Wave-Solar-Double Compensated Capacitive Energy Storage Based Interconnected Power System. *Energies* **2022**, *15*, 6959. https://doi.org/10.3390/en15196959

Academic Editor: Juri Belikov

Received: 22 August 2022
Accepted: 15 September 2022
Published: 22 September 2022

1. Introduction

The principle of automatic generation control (AGC) is to maintain the balance between power generation and power demand along with losses [1–3]. If this equilibrium is not maintained then it will lead to excessive fluctuations from the nominal values of frequency and tie-line power connecting areas. Back in earlier days, most of the literature in AGC learning highlighted work in isolated systems [4–6]. Later works were reported on

International Journal of Energy and Environmental Engineering
https://doi.org/10.1007/s40095-022-00547-9

ORIGINAL RESEARCH

Influence of solar and solid oxide fuel cell in AGC learning by utilizing spotted hyena optimized cascade controller

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Received: 4 April 2022 / Accepted: 21 October 2022

Abstract

The present work explores automatic generation control learning for manifold area and sources under traditional situations. Sources in area-1 are thermal, biodiesel; thermal and gas plant in area-2; and thermal, split-shaft gas turbine (Ss(GT)) in area-3. An original strive has been set out to execute cascade controller with the amalgamation of proportional with tilt–integral–derivative with filter (TIDN) and fractional-order integral–derivative (FOID). TIDN and FOID are in series connection, hence named TIDN-FOID. Various scrutiny expresses excellency of TIDN-FOID controller over proportional–integral–derivative filter (PIDN) and TIDN from outlook regarding the lessened level of peak overshoot, extent of oscillations, peak undershoot as well as settling time. In an endeavour to procure the controller's gains and parameters, bioinspired meta-heuristic spotted hyena optimizer (SHO) is applied. It is also observed that the presence of a renewable solar source makes the system significantly better compared to the base thermal–biodiesel–gas–Ss(GT) system. TIDN-FOID performance is also observed to be excellent in the presence of solar for both 1% step load disturbance and random load pattern individually. Fixed as well as variable insolation for solar is analysed separately. The performance of solid oxide fuel cell (SoFC) is also examined using the TIDN-FOID controller, which provides with noteworthy outcome in dynamic performance for both types of disturbances. Also, sensitivity analysis is performed, and it is observed that the values of the TIDN-FOID parameters at nominal conditions are appropriate for a higher value of disturbance.

Keywords Automatic generation control · Biodiesel plant · Solar thermal power plant · Solid oxide fuel cell · Spotted hyena optimizer · TIDN-FOID controller

List of symbols

f	Frequencies set point value. Hertz (Hz) is unit
*	Exponent implies best number
i	Subscripted value implies to area number
B_i	Coefficient of frequency bias of the concerned area
T_{ij}	Coefficient of synchronization
T	Time of simulation in seconds
Δf_i	Alteration of frequency of concerned area
ΔP_{Di}	Amount of load alteration of concerned area
H_i	Amount of inertia constant of concerned area
D_i	$\Delta P_{Di}/\Delta f_{\mathrm{i}}$ (p.u MW/Hz)
R_i	Parameter of speed regulation of governor of concerned area
β_i	Characteristics of frequency response of concerned area
K_{pi}	Gain of power system block
T_{pi}	Time constant of power system block
P_{ri}	Considered rated power of an area
a_{ij}	(P_{ri}/P_{rj})
pf_{iv}	Area participation factor for area-i, $i=1$, 2, 3 and $v=1$, 2, 3
T_{gi}, T_{ti}, T_{ri}	Time constants of governor, turbine and reheater of thermal generating units in seconds (s) of concerned area

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Published online: 03 November 2022

sustainability

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Article

Dynamic Stability Evaluation of an Integrated Biodiesel-Geothermal Power Plant-Based Power System with Spotted Hyena Optimized Cascade Controller

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Citation: Saha, A.; Dash, P.; Babu, N.R.; Chiranjeevi, T.; Dhananjaya, M.; Knypiński, Ł. Dynamic Stability Evaluation of an Integrated Biodiesel-Geothermal Power Plant-Based Power System with Spotted Hyena Optimized Cascade Controller. *Sustainability* **2022**, *14*, 14842. https://doi.org/10.3390/su142214842

Academic Editors: Marek Jasinski, Zbigniew Leonowicz, Michał Jasiński and Elżbieta Jasińska

Received: 4 October 2022
Accepted: 7 November 2022
Published: 10 November 2022

Abstract: The perception of automatic generation control (AGC) has a massive part in delivering eminence power in an interrelated structure. To acquire eminence power by monitoring the fluctuations of frequency and tie-link power, an appropriate controller strategy is essential. This work explores AGC learning under the traditional situation. In this study, we employ a cascade controller with proportional amalgamation with a tilt-integral-derivative with a filter (TIDN) and fractional order integral-derivative (FOID), named TIDN-FOID. In order to acquire the controller's attributes, a meta-heuristic optimization algorithm spotted hyena optimizer (SHO) is employed. Several investigations express the excellency of the TIDN-FOID controller over other controllers from outlook regarding the lessened level of peak_overshoot, peak_undershoot, and settling_time for the considered structure. The structure comprises thermal, biodiesel units in area 1, thermal, and geothermal units in area-2, and hydrothermal units in area-3. Both biodiesel and GPP have a better effect on system dynamics even in the presence of time delay. Action in the redox flow battery is also examined, providing a noteworthy outcome. Eigenvalue assessment is carried out to comment on the stability of the system. TIDN-FOID parameter values at nominal conditions are appropriate for a higher disturbance value without the need for optimization.

Keywords: automatic generation control; geothermal power plant; redox flow battery; biodiesel plant; spotted hyena optimizer; particle swarm optimization; controller; time delay

1. Introduction

Proper coordination between the amounts of power generation and demand and losses is essential for better power system performance. This balance may be disrupted during periods of heavy load demand. If this balance is not maintained or observed at the right time, it may lead to huge damage by providing huge aberration in frequency and tie-line power from the base values. These disproportions were subdued by the conception of AGC [1–3]. Elgerd et al. [4] provided the basic mathematical formulation of AGC in the case of a two-area thermal system. In the past, works on AGC were mainly confined to a single area system [5–7]. Later, studies included two-area [8,9], three-area [9–11], four-area [12],

SN Computer Science (2023) 4:138
https://doi.org/10.1007/s42979-022-01556-5

ORIGINAL RESEARCH

Bird Swarm Algorithm Optimized TIDD Controller for Multi-area Load Frequency Control Application

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Received: 8 September 2022 / Accepted: 10 December 2022 / Published online: 4 January 2023

Abstract

This article presents the application of bird swarm algorithm optimized tilt-integral double derivative controller for multi-area load frequency control. The proposed system comprises one thermal and realistic dish-Stirling solar thermal system unit in each area. A novel controller named as tilt-integral-double derivative controller has been designed as a supplementary controller. The bird swarm algorithm has been successfully utilized to optimize the controller and other parameters. The comparative analysis of system dynamics responses with proportional-integral-derivative, tilt-integral-derivative, and tilt-integral-double derivative controllers concluded that the system with proposed tilt-integral-double derivative controller outperformed in terms of peak overshoots, undershoots and settling time. The system dynamics performance is also analyzed with proposed tilt-integral-double derivative controller considering various optimization techniques such as crow search, cuckoo search and bird swarm algorithm, and it is observed that the system performance with proposed algorithm provides better dynamics and also converge faster than other optimization techniques. The study of realistic dish-Stirling solar thermal system integration on system dynamics explored improves in system dynamic performances. Moreover, the sensitivity analysis suggested that it is not necessary to change the system loading or other parameters for the wider range.

Keywords Load frequency control · Birds swarm algorithm · Realistic dish-Stirling solar thermal system · Tilt-integral-double derivative controller

Introduction

The modern power system has become a high complex network because of its consistent growth in size. On the other hand, the intermittent nature of load demand added a new challenge in practical power system. As a result, maintaining the power system frequency at prescheduled value and real

This article is part of the topical collection "Enabling Innovative Computational Intelligence Technologies for IOT" guest edited by Omer Rana, Rajiv Misra, Alexander Pfeiffer, Luigi Troiano and Nishtha Kesswani.

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İSTANBUL UNIVERSITY CERRAHPAŞA

ORIGINAL ARTICLE
Electrica 2023

Crow Search Algorithm-Optimized Cascade Controller in a Multi-Area Thermal Wind Integrated System and Its Real-Time Validation

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Cite this article as: N. Ram Babu, T. Chiranjeevi, A. Saha, S. Kumar Bhagat, U. Kumar Gupta and R. Ishwar Vais, "Crow search algorithm-optimized cascade controller in a multi-area thermal wind integrated system and its real-time validation," *Electrica*, March 29, 2023;DOI: 10.5152/electr.2023.22137.

ABSTRACT

This article explores the load frequency control (LFC) problem for manifold areas and sources under conventional situations. An attempt has been made to demonstrate the solicitation of a real-time simulation laboratory for the LFC studies of three thermal area systems. Thermal systems are integrated with renewable like wind systems in area-1, 2 respectively. A novel ancillary controller termed by cascade tilt integral-proportional integral derivative (TI-PID) is suggested and is augmented by crow search algorithm. The superiority of TI-PID controller is tested and found to be better with PID and tilt integral derivative (TID) controller. Moreover, the obtained responses with hybrid peak area-integral square error are compared with ISE, and it shows better responses over ISE. Further, the responses with alternating current-high-voltage direct-current system improve system dynamics over wind-thermal and thermal systems. Furthermore, sensitivity analysis suggests that the TID with filter controller considerations attained at nominal circumstances are vigorous.

***Index Terms*—**Load frequency control, cascade controller, hybrid peak area-integral square error, crow search algorithm, wind system

Nomenclature	
ΔF, ΔP_{tie}	Frequency and tie-power variation
R_j	Regulation parameter (Hz/ p.u. MW)
a_{jk}	$-(P_{rj}/P_{rk})$
T_{tj}, T_{gj}, T_{rj} and T_{WTSj}	Governors, turbine, reheat and WTS time constant
K_{rj}, $K_{WTS,j}$	Coefficient of reheat and WTS turbine
K_{Tij}, K_{Pij}, K_{Iij}, K_{Dij},	Tilt, proportional, integral, derivative and filter gains of T/PIDN controller

I. INTRODUCTION

The primary use of load frequency control (LFC) is to diminish the misalliance amid the load and generation units [1]. Violation of this misalliance inclines to abnormalities in frequency and power. The prompt LFC works started through sole [2] and protracted to multiarea works [3]. [4, 5] demonstrated an LFC study with generator rate constraints (GRC) and governor dead band. The excess emission of carbon fuels and decrement of fossil fuels tends to the penetration of renewable energy sources. Renewable energy sources like Wind, solar dictates over others. Authors in [6-10] presented the integration of wind [6], solar thermal power plant [7-9], and dish-Stirling solar thermal system [10] with solitary of thermal two-area. Hence, the amalgamation of wind in three-area systems necessities investigations.

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Received: July 25, 2022

Accepted: November 6, 2022

Publication Date: March 29, 2023

DOI: 10.5152/electr.2023.22137

Received: 22 November 2022 | Revised: 18 May 2023 | Accepted: 23 May 2023

IET Renewable Power Generation

DOI: 10.1049/rpg2.12771

The Institution of Engineering and Technology WILEY

ORIGINAL RESEARCH

Dynamic stability assessment of interconnected thermal-SsGT-solar photovoltaic-EV power system with ARO optimized IDN-FOID amalgamated controller

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Abstract

To succeed over the sudden load-frequency variations in interlinked power systems, an equilibrium must be maintained between power generations and losses. The major problem associated to manifold interlinking arenas of power systems is load frequency control. In this paper, a multiple-arena scheme is examined which encompasses thermal and split shaft gas turbine plants. Here, artificial rabbit optimization (ARO) is applied to procure the premium standards of the supplementary controller. The projected controller is the amalgamation of integer order integral-derivative with filter (IDN) and fractional order integral-derivative (FOID). So, the amalgamation is IDN-FOID. Henceforth, the ARO augmented IDN-FOID controller is recognized. The ARO augmented IDN-FOID supplementary controller delivers enhanced outcomes related to additional secondary controllers like I, PI, and PIDN. Valuation articulates about the improved act of ARO over added algorithms using the IDN-FOID controller related to converging nature, transient profile, and steady-state assessment. Assessment is done in the presence of non-linearities in generation rate constraints and time delay. It is also detected that scheme potent outcomes with the IDN-FOID controller are superior when the scheme is instructed with solar photovoltaic, electric vehicles, solid oxide fuel cells, and ultra-capacitor. The ARO optimized IDN-FOID controller is the anticipated arrangement for the measured scheme.

1 | INTRODUCTION

1.1 | General introduction and literature survey of related works

A steady relationship between the quantity of power generated and loss is the elementary requirement of a power system. This steadiness is very problematic to acquire during high peak periods. The discrepancy is replicated in the frequency and tie-line powers. If these inconsistencies persist for an elongated time, then it leads to enormous damage. These discrepancies are overcome by the perception of automatic generation control (AGC). Elgerd [1] has executed the arithmetic architype of AGC. Guha et al. [2] reported a study regarding thermal plants as generating units. Padhan et al. [3] have studied a two-area thermal system. Dash et al. [4, 5], have analyzed a two-area thermal system. Dhamanda et al. [6] studied a thermally incorporated four-area system. Apart from thermal sources, many others have also reported the inclusion of hydro or gas elements. Rahman et al. [7] have undergone analysis of a hydro-thermal system. Arya [8] has analyzed an AGC system comprising of hydro, thermal, and gas generating units. Saha et al. [9] have undergone analysis with the involvement of a split-shaft gas turbine (SsGT). Due to excessive usage, fossil fuels are degrading at a very fast pace, so it is very much needed to use renewable sources like solar and wind for power generation. Acharyulu et al. [10] have

Comparative Analysis of Various Energy Storage Systems in a Conventional LFC System Considering RDSTS, PWTS and AHVDC Models

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Abstract: This article examines the performance of various energy storage systems (ESS) in a traditional load frequency control (LFC) interconnected system. ESS like capacitive systems (CS), battery systems (BS), ultra-capacitors (UC), redox flow batteries (RFB) and their combinations are explored. The explored system comprises of conventional three-area thermal with realistic dish-striling solar thermal system (RDSTS) in area-1, precise wind turbine system (PWTS) in area-2 and RDTS-PWTS in area-3. The performance of cascaded PI with PIDN as a secondary controller is employed for the first time. The controller values are simultaneously optimized by hybrid crow search algorithm (HCSA). The effect of introducing RES like RDSTS and PWTS have been studied, and the results shows that RES leads to superior dynamics over thermal. A novel performance index namely HPA-ISE is anticipated and shows improves responses over ISE. Also, investigations are carried on optimal AHVDC and ESS locations. Moreover, the responses with AC-AHVDC and ESS highlights the predominance of ESS over AC-AHVDC and thermal systems. Further, studies comparing other ESS reveal that RFB performs them. Furthermore, when RFB is combined with UC and CS, it is discovered that RFB-UC produces better results.
Keywords: Load frequency control; HPA-ISE; AHVDC with ESD; PWTS; RDSTS

Nomenclature

HPA-ISE	Hybrid peak area-integral squared error	PI	Performance index
LFC	Load frequency control	HCSA	Hybrid crow search algorithm
RDSTS	Realistic dish Stirling solar thermal system	PWTS	Precise wind turbine system
AHVDC	Accurate high voltage direct current	CS	Capacitive systems
RFB	Redox flow battery	ESS	Energy storage systems
BS	Battery systems	UC	Ultra capacitor
PS	Power system	TF	Trasnfer function
PUS	Peak undershoot	POS	Peak overshoot
ST	Settling time	RES	Renewable energy sources

1. Introduction

The modern PS has become sophisticated network due to its increase in capacity. In addition, the balance of real power among generation and load has become a crucial concern. With discrepancy the PS experiences power and frequency profile variations and effects PS stability. This is something that LFC, as an additional service deals with. LFC goal is to keep the PS parameters close to nominal values [1, 2]. The first LFC projects focused on isolated systems, followed by multi-area systems [3 – 5]. Later, the authors created a realistic thermal system with GRC, GDB and droop.

Fossil fuels are used to generate electricity, and their continued use has resulted in their extinction. The adoption of RES with the prevailing PS was prompted by the depletion of fossil fuels and its associated environmental concerns. Solar and wind provides substantial benefits over other RES [6, 7]. Renewable like wind, DSTS, solar-thermal and geo-thermal are considered for two and three-area AGC systems [8 – 12]. From literature, only a limited effort has put into AGC addressing renewable sources. Li et al. [13 – 15] modified a DSTS model by considering a fixed-speed-DSTS with non-minimum phase characteristics, thus mitigating transient droop

IEEE Access
Multidisciplinary | Rapid Review | Open Access Journal

Received 14 October 2022, accepted 19 February 2023, date of publication 28 February 2023, date of current version 8 March 2023.

Digital Object Identifier 10.1109/ACCESS.2023.3250181

RESEARCH ARTICLE

An Improved Parametric Method for Selecting Different Types of Tesla Transformer Primary Coil to Construct an Artificial Lightning Simulator

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ABSTRACT Due to the intermittent and hazardous nature of lightning impulse, researchers rely on artificial impulse generators to study it. The Tesla coil is a commonly used device to generate artificial lightning. This paper presents a parametric analysis of the primary side coil of the Tesla transformer. The analysis employs seven key electrical properties: skin depth, current density, voltage distribution, Ohmic loss, electric field strength, charge density, and energy content. These parameters are used to evaluate the response of various coil types to high voltage impulses. The Ansys high-frequency electromagnetic solver is used to perform a comparative analysis of essential parameters. The results can aid lightning researchers and Tesla coil designers in determining the optimal designs for Tesla primary coils in the future. The analyzed data is validated using Tesla coil hardware, which is used as an artificial lightning producer to test the feasibility of a lightning energy harvester.

INDEX TERMS Ansys, flat spiral coil, helical coil, high voltage test, inverse conical coil, impulse generator, lightning energy, Tesla coil.

I. INTRODUCTION

Nature is the mother of all mysteries, and one of the most captivating is lightning. This natural wonder has intrigued humans for centuries, with its power and unpredictability making it a fascinating subject of study. Researchers have been striving to harness its energy for decades. Lightning is a scintillating light flash that occurs when static electricity is suddenly discharged into one or more charged regions in the atmosphere. It can occur within a single cloud, between different clouds, or between the clouds and the atmosphere or ground. As a natural surge, it can be both fascinating and hazardous [1], [2]. The experimental report of Bhattarai and Potapov also agreed that lightning strokes might have a kA range of current magnitude. They also claimed that a single stroke might deliver 250kWh energy and 30kA current [3], [4]. Hasbrouck, Rakov, and later Cao explored and reported that insulation breakdown of air ensues approximately at 5MV. They also have confirmed that a lightning bolt conveys almost 30 kA current with almost 150kWh energy on average [5], [6]. While a lightning bolt possesses a significant amount of energy, effectively harnessing and storing it is a challenging endeavor due to the unpredictable and perilous nature of lightning [7].

Due to the nature of lightning, the impulse generator takes place as a lightning simulator in modern lightning research. This device is an electrical contraption that originates impetuous high-voltage or high-current surges [8].

The associate editor coordinating the review of this manuscript and approving it for publication was Lei Chen.

https://doi.org/10.1007/s12633-023-02288-8

ORIGINAL PAPER

Role of Fin Shape on Drain Current of SiO_2/HfO_2 Based Trigate FinFET Including Quantum Mechanical Effect

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Received: 26 October 2022 / Accepted: 3 January 2023 / Published online: 26 January 2023

Abstract
A compact Lambert W function-based model is proposed to analyze the drain current of three different fin-shaped Trigat (TG) FinFETs, namely rectangular (RE_TG), trapezoidal (TZ_TG) and triangular (TI_TG) FinFET. Quantum mechanica effect (QME), channel length modulation (CLM), effective mobility, corner effect and modified drain voltage are included t achieve precise drain current in all operating regimes. The comparison between the three cross-sections is examined in con nection with threshold voltage, drain current, output conductance and transconductance. Better performance regarding drai induced barrier lowering (DIBL), subthreshold swing (*SS*) and threshold voltage roll-off is noticed for TI_TG FinFET. Maxi mum drive current (I_{on}) is observed for RE_TG FinFET. The effect of HfO_2 is also addressed in the cross-sections describe above. The prediction of the mathematical model is authenticated using technology computer-aided design (TCAD). Th outcome of the model is also compared with the fabrication result. An outstanding harmony with the TCAD simulation an the published experimental result verifies the potentiality of this model.

Keywords FinFET · Threshold voltage · Drain current · Lambert W function · QME

1 Introduction

The downscaling of metal oxide semiconductor field-effect transistor (MOSFET) has led to many short channel effects (SCEs). Power gating, variable threshold complementary metal–oxide–semiconductor (CMOS), transistor stacking are existing methods to reduce SCEs, but not appropriate for technology under 22 nm. So, miniaturization of the physical dimension is inadequate for high-performance short channel devices. Not only the physical dimension of the device but the scaling of SiO_2 below 1.5 nm is also limited because of the high leakage current and generation of surplus heat. These will cause the degradation of the device parameters. Hence, a structural change of the device dimension and replacement of SiO_2 with high-k materials like HfO_2, ZrO_2 etc., are required to achieve better performance and high packing density. In this context, th development of FinFET technology creates a scholarly impac on the semiconductor industry. It is a non-planer structure wit a vertical fin-like channel, controlled by multiple gates [1]. I bulk FinFET technology, fin is a part of the body. In Silicon o Insulator (SOI) technology, circumventing the leakage, fin i not connected with the body. The multiple gates provide bette electrical control. Therefore, FinFET not only reduces leak age current but also minimizes SCEs, threshold roll-off an subthreshold swings (*SS*) [2, 3]. A mathematical model of SC FinFET is prescribed by N. Srivastava and P. Mani. Varying th device dimensions, they concluded that a larger device dimen sion provides a higher driving current, whereas a smaller size device provides better immunization against SCEs [4].

Junctionless (JL) FinFET is another variation of Fin FET. A negative capacitance (NC) JL FinFET is reporte by Kaushal, S., Rana, A.K., and Sharma [5]. It reduces th SCEs, namely *SS*, DIBL and leakage current with high driv current and fast switching. The authors also argued that dif ferently graded JL structures are a superior option in term of subthreshold logic applications than laterally graded (LG JL FinFET [6]. A comparison between the JL-FinFET an negative capacitance (NC) JL-FinFET has been reporte and stated that NC-JL FinFET offers 80% improvement i

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Engineering Research Express

PAPER

Impact of fin width on nano scale tri-gate FinFET including the quantum mechanical effect

RECEIVED
6 December 2022

REVISED
23 April 2023

ACCEPTED FOR PUBLICATION
3 May 2023

PUBLISHED
18 May 2023

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Keywords: TG-FinFET, threshold voltage, QME, TCAD, DIBL

Abstract

An inversion charge-based threshold voltage model is proposed for 10 nm channel length Tri-gate (TG) FinFET. The variation threshold voltage has been studied with respect to fin width (W_{fin}) for different fin height (H_{fin}) and channel length (L). The effect of width quantization has been explained with the help of the quantum mechanical effect (QME). A precise comparison of threshold voltage in terms of classical mechanics and quantum mechanics depicts the presence of width quantization in short channel device. The improvement of the short channel effects (SCEs), like subthreshold swing (SS), drain-induced barrier lowering (DIBL) and threshold voltage roll off have been studied. The impact of channel length to fin width ratio on DIBL and *SS* has been examined. The improvement of the SCEs at the same oxide thickness has been observed for high-k dielectric material. The potential and effect of hafnium oxide (HfO_2) have been discussed and validated using technology computer-aided design (TCAD) simulation.

1. Introduction

According to Moore's law, the information processing power in an integrated circuit (IC) must be increased in every two years [1]. Several strategies, such as miniaturization of device dimensions, silicon on insulator (SOI) technology etc, have been developed [2]. In comparison, the multi-gate transistor is the most booming technology that meets current trends in the IC industry [3]. A MOSFET is referred to as a multi-gate device or transistor if it incorporates more than one gate into a single device. Triple-Gate (TG) FinFET has become the most promising next-generation of CMOS technology. It can also be scaled down to the deca-nanometer range [4]. The presence of multi-gates can better withstand the short channel effects, namely drain-induced barrier lowering, threshold voltage roll off (ΔV_T) and subthreshold swing (*SS*) [5, 6]. Due to these advantages, FinFET is used to design the D-latch module [7].

The name '*FinFET*' comes from the fact that the channel is formed with an undoped fin like a vertical piece of Silicon covered by a thin oxide layer. In TG-FinFET, the gate covers the Si fin from the three sides. Hence, the channel under the control of three gates produces overall improved device characteristics. Due to the aggressive miniaturization of the device structure, the SCEs, such as DIBL and *SS* increase rapidly when the channel length (L) to fin width (W_{fin}) ratio (L/W_{fin}) falls below 1.5 [8, 9]. Whereas the on-current is large for smaller dimensions. Therefore, there will be a trade-off between SCEs and the device's on-current. On the other hand, quantum mechanical confinement is the integrated part of the short channel device having W_{fin} less than 10 nm. Rather than classical mechanics, quantum mechanics can better clarify the electrical parameters, such as the threshold voltage in such short-fin structured devices [10–12]. The performance of multiple-gate SOI MOSFETs including the quantum effects was examined by Palanichamy and Balamurugan [13]. An quantum mechanical effect (QME) was also proposed by Colinge but QME was not included in V_T model [14].

Materials Chemistry and Physics 298 (2023) 127466

Contents lists available at ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Structural modifications, optical response, and electrical conductivity mechanism of Bi_2O_3 doped in P_2O_5–V_2O_5–MoO_3 nanocomposite glass systems

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HIGHLIGHTS

- Structural characterization of the xBi_2O_3-(1-x)(0.30P_2O_5-0.35V_2O_5-0.35MoO_3) [x = 0.05, 0.15, 0.25, and 0.35] glassy system.
- The incorporation of Bi atom decreases the optical band gap energy of the studied lasses.
- DC conductivity has been analyzed by using Mott and Greaves's model.
- Electrical conduction relaxation has been analyzed by using Pan and Ghosh model.
- Several spectroscopic parameters are estimated and discussed.

ARTICLE INFO

Keywords:
Quaternary glass nanocomposite
X-ray diffraction
AC and DC conductivity
Correlated barrier hopping model
Pan and ghosh model
Optical bandgap

ABSTRACT

Structural, optical and electrical conductivity mechanism of four compositional series of xBi_2O_3-(1-x)(0.30P_2O_5–0.35V_2O_5–0.35MoO_3) [x = 0.05, 0.15, 0.25, and 0.35] have been investigated. XRD pattern affirms the existence of nanocrystallites in the glassy network, which affects the structural, optical and electrical alterations. The structural variation leads to an increase in the density of all the glassy systems. The FTIR analysis reveals the shift of different band positions suggesting structural alterations. The electrical conductivity investigation reveals the decreasing values of ac and dc activation energy, which enhances the ac and dc conductivity. The validity of Mott's VRH model has been examined and the value of hopping energy has been estimated. The obtained DC conductivity spectra of all samples have been fitted with Greaves's model. The AC conductivity scaling model of Pan and Ghosh has been used to demonstrate the electrical conduction relaxation method. In the spectroscopic investigation, by deploying the Tauc's plot, the optical band gap energies of the studied glass compositions are estimated. The calculation of Urbach energy values allows us to estimate the disorders of glassy nanocomposites. Different spectroscopic parameters like refractive index, polarizability, reflection factor, and reflectivity have been studied.

1. Introduction

In the research field, phosphate glasses have become an important material owing to distinctive physical characteristics such as lower melting and glass transition temperatures, high coefficients of thermal expansion, higher electrical conductivity in the low-temperature region, ultraviolet (UV) transmission and optical characteristics [1]. The applicability of phosphate glasses is often restricted due to their weak

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https://doi.org/10.1016/j.matchemphys.2023.127466
Received 19 May 2022; Received in revised form 24 January 2023; Accepted 2 February 2023
Available online 7 February 2023

Materials Chemistry and Physics 296 (2023) 127187

Contents lists available at ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Tunable band gap, CB and VB positions of multicomponent $Se_{65-x}Te_{20}Ge_{15}Sn_x$ chalcogenide glassy systems: Effect of metallic additives on physical and optical parameters

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HIGHLIGHTS

- Quaternary chalcogenide glassy system have been prepared by melt quenching method.
- Compositional dependence of several physical and optical parameters have been studied.
- Tauc's-plot method has been deployed to determine optical band gap energy.
- The WDD model has been deployed to analyze the dispersion parameters.
- The CBA method has been deployed to estimate the bond distribution and the cohesive energy.

ARTICLE INFO

Keywords:
Optical band gap
WDD model
Plasma frequency
CBA method
CB and VB potential

ABSTRACT

In the present communication, the compositional dependency on physical, and optical properties of chalcogenide $Se_{65-x}Te_{20}Ge_{15}Sn_x$ (x = 5, 10, 15, and 20 at. wt. %) glassy systems have been studied. A comprehensive evaluation of various physical and optical parameters has been analyzed systematically. The spectroscopic parameters have been determined from the transmittance and reflectance spectra using spectrophotometric measurements in the range of 200 nm–1200 nm. The optical energy band gap of the as-prepared samples has been evaluated by deploying Tauc's plot method and is observed to decrease from 1.28 eV to 0.93 eV, while the calculated Urbach energy is observed to increase from 0.110 eV to 0.208 eV with the increasing content of the metallic additives. By using the Wemple-Di Domenico model, the dispersion parameters of the samples are obtained and discussed comprehensively. An increase in Sn content is found to affect the absorption coefficient, extinction coefficient, refractive index, optical density, skin depth, and optical conductivity of the glassy systems. By using the chemical bond approach the estimated cohesive energy values are found to increase from 45.39 kcal/mol to 46.75 kcal/mol. Moreover, the location of conduction and valence band edge has been estimated to examine the potential of the synthesized samples as a semiconductor device. The analyzed properties make the multicomponent Se–Te-Ge-Sn chalcogenide system, a potential candidate for numerous device applications.

1. Introduction

In the present time, chalcogenide semiconductors have evolved as multifunctional materials due to their outstanding structural, spectroscopic, and electrical properties and their widespread applications in science and technology [1–3]. The metal incorporated chalcogenide

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https://doi.org/10.1016/j.matchemphys.2022.127187
Received 23 October 2022; Received in revised form 30 November 2022; Accepted 10 December 2022
Available online 17 December 2022

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 161-172 www.ijaem.net ISSN: 2395-5252

Analysis of Different Limnological Parameters and Cultural Eutrophication of Kalyani Lake, West Bengal, Nadia

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Date of Submission: 01-09-2022 Date of Acceptance: 10-09-2022

ABSTRACT
The present study deals with some limnological parameters of water of Kalyani lake in district Nadia, West Bengal to determine whether the water quality is suitable for fish culture or not. A total of nine physic- chemical parameters were measured for a period of one year (March'2011-February'2012) in three different seasons to assess the pollution load and present status of the lake following the standard method of APHA'1995. The parameters showed distinct temporal or seasonal variation. The low DO level and high level of nutrient values indicate the poor water quality of the lake for human consumption and fish culture also. The depletion of water quality is mainly due to the daily assemblage of huge amount of raw sewages from neighbouring sites, bathing of human and cattle, washing of cloths and utensils, dumping of solid wastes etc. This survey reflects the higher degree of pollution in Kalyani Lake.

KEYWORDS: Limnological parameter, Water quality, Kalyani Lake, Pollution, Cultural Eutrophication

I. INTRODUCTION

To understand the lake's physical chemical and biological properties which is very much essential to determine lake condition. In recent years almost half of the world's lakes are polluted, degraded and contaminated by various anthropological activities. The main causes of such pollution are domestic sewages,agricultural run-off, inflow of untreated effluents from different industries, habitat degradation, over-fishing, rapid rate of urbanisation etc**. Kalyani Lake of district Nadia** is a shallow type of freshwater lake and is used for carp culture (especially Indian major carps or IMCs).

Kalyani is a small industrial town of the state West Bengal, so usually there have some pollution problem due to rapid rate of industrialisation and urbanisation. The aforesaid lake is being polluted by a number of human activities such as bathing, washing their clothes, utensils etc. Moreover a huge amount of solid wastes and household sewages from the surroundings also reduce the water quality of the lake, which will be detrimental to the fisheries activities in near future of this area.

KALYANI LAKE ENTRANCE GATE

U.Porto Journal of Engineering, 8:6 (2022) 48-61
ISSN2183-6493
DOI: 10.24840/2183-6493_008.006_0004

Received: 2 October, 2021
Accepted: 13 June, 2022
Published: 28 November, 2022

Understanding the Trends in Welding of Copper and Steel

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Abstract
Copper-steel welded joints are now used widely in heat exchangers, piping and power generation industries. Owing to their different thermal characteristics, sound welding of the pair is a challenging task. Extensive research is carried out to achieve successful welding of copper and steel. This article presents an insight into the works done on the joining of copper and steel by various techniques. The microstructural modifications in different approaches are critically presented. Mechanical properties of joints obtained through different techniques are compared.

Author Keywords. Copper. Steel. Dissimilar Welding. Microstructure. Microhardness. Tensile Strength.

Type: Research Article
Open Access Peer Reviewed CC BY

1. Introduction

Owing to good thermal conductivity, excellent corrosion resistance and high ductility, copper alloys are widely used as a thermal conductive material in chemical and metallurgy industries. However, the low strength and high thermal expansion of copper limits its uses in different industrial applications. Therefore, the joining of copper with high-strength alloys such as steel is of great attention to researchers. The bi-metallic joint of copper steel is extensively used in heat exchangers in nuclear and power generation industries. Both fusion weldings and solid-state weldings were used by researchers to obtain copper-steel joining.

The major difficulty in fusion welding of copper and steel is the huge difference in their thermal properties. The higher thermal conductivity of copper results in the dissipation of heat from the weld zone. Also, the difference in thermal expansion coefficient results in difference in shrinkage during cooling. This leads to the generation of residual stress and consequently leads to crack generation in the weldment. Therefore, special attention is required to control the heating and cooling of the fusion joint to achieve defect-free joining. Moreover, the differences in the metallurgical aspects of the two materials are concerning aspects of achieving successful joining between them. Due to the metallurgical differences, in the liquid phase, the materials tend to get separated, which leads to copper inclusion and hot cracking. Besides laser welding and electron beam welding, TIG and other arc welding processes also were used for the welding of copper and steel. The Fe-Cu phase diagram (Figure 1) suggests that solid-state copper-steel bonding can be achieved at elevated temperatures. Therefore, several solid-state techniques such as explosive welding, friction welding, diffusion bonding, etc., were attempted for the successful fabrication of copper-steel joints.

Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

An overview on friction stir welding/processing tools

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Friction stir welding
Friction stir processing
Tool design
Shoulder
Pin
Materials

ABSTRACT

Friction stir welding is a simple, efficient and eco-friendly manufacturing technique. Friction stir processing is a modified and composite fabrication version of the FSW. In these processes, a rotating tool comprising of a pin and a shoulder mixes the materials around it. The shoulder part of the tool generates the major fraction of the frictional heat which softens the workpiece material. The pin stirs the semi-solid material to achieve the joining/ composite. Therefore, the tool is the major part of the FSW/P as the tool significantly controls the heat generation and material movement which is essential for defect free product. However, the major challenges of the tool include tool wear (particularly for high strength metals and alloys) and complex method of tool fabrications. In this article, the FSP tools and their geometry, materials along with the wear behavior have been thoroughly reviewed. In addition to the recent developments in tool design and the scope of future research are also discussed.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Artificial Intelligence & Energy Systems.

1. Introduction

Friction Stir Welding (FSW), invented by TWI [1] is a solid state welding technique in which the weld materials is heated by frictional heat and stirred in semi-solid state to achieve joining. In this process a tool, typically comprise of a shoulder and a pin is inserted into the edges of the plates to be welded. The rubbing action of the shoulder and the pin with the plate generates the frictional heat and softens the material into semi-solid state. The rotation of the pin stirs the plasticized material with it and forges at the back end of the shoulder. A schematic representation of FSW is illustrated in Fig. 1. Later, this technique is also being used for grain modification, homogenization and for fabrication of surface and bulk composites [2–5] and is termed as Friction Stir Processing (FSP). FSW/P is an emerging green technology as it has very low impact on environment with efficient use of energy. FSW was initially introduced for welding of aluminum. However, with further researches it is now being used for magnesium, copper, polymers, Ti, Steel and even for MMCs [6–9]. Since last few decades, FSW/P route has emerged as one of the mostly used techniques for fabrication and joining of composites owing to fine grain structure, uniform particle distribution and high strength of the final product [10–13].

Heat generation in FSW/P depends on the friction between the tool and workpiece. Therefore, the geometry of the tool as well as the tool material significantly controls the heat generation along with the process parameters such as rotational speed, traverse speed etc. [14]. The shoulder contributes the majority of the heat as compared to the pin. However, the pin controls the movement of plasticized materials during welding. Therefore, the design of shoulder and pin is very much essential for sound welding/processing. Also, as the tool comes in direct contact with the weld material, degradation of tool is also need to be considered during selecting the appropriate tool for FSW/P. Therefore, several researches are being carried out to optimize the tool for both welding and processing.

In this article, a critical evaluation is made on FSW/P tools. The necessary properties of tool materials are discussed and commonly used tool materials are addressed. Required considerations on geometry of FSW/P tools are addressed thoroughly. Moreover, the recent advancements in tool design are also considered.

2. Tool materials

The materials of the tool play a crucial role in tool wear and depend on the workpiece material. The selection of the tool material sometimes depends on the practical experience during the

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https://doi.org/10.1016/j.matpr.2022.01.009
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the International Conference on Artificial Intelligence & Energy Systems.

Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Fabrication of Aloe vera nanopowder by high energy ball mill process

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Aloe vera leaves
High energy planetary ball milling
Nano particle

ABSTRACT

Since Rigvedic, Aloe vera has been utilized for vitality, wellbeing, and medicinal reasons. Aloe vera is used for wound healing, curing burns, minimizing frostbite damage, preventing skin from X-ray damage, lung cancer, digestive disorders, raising high-density lipoprotein (HDL), and decreasing blood sugar in diabetics, combating acquired immune AIDS, allergies, and stimulating the immune system. In the present investigation, aloe vera nanopowders are fabricated by high energy planetary ball milling. The synthesized Aloe vera nanoparticles are characterized using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Analysis (EDX). Moreover, to examine the chemical structure of the nanoparticles and to measure the particle size, Fourier Transform Infrared Spectroscopy (FTIR) analysis has been performed. In addition, to determine the average size of the aloe vera nanoparticles, X-ray diffraction (XRD) on the specimen has been performed. It is interesting that the particle size of the Aloe vera powders is successfully decreased under the estimated optimal milling conditions.

Selection and peer-review under responsibility of the scientific committee of the Second Global Conference on Recent Advances in Sustainable Materials 2022.

1. Introduction

Aloe vera gets its name from a combination of Arabic and Latin words: "Alloeh" in Arabic means "sparkling bitter material," and "vera" in Latin means "truth" [1]. It is a xerophyte that grows in a rosette at the stem, with thick, beefy, pointed leaves. The leaves are encased in a gel made up of 98 % water and 0.66 % solids that arise from the parenchyma cells. In general, the plants have to tolerate lengthy periods of deficiency. Aloe vera is inhabitant to Northern Africa, although it can also be found along the Nile in the Mediterranean, India, South America, and South Africa [2]. It has no or very small stems and grows to be 80 to 100 cm tall, scattering by balance and root shoots (Fig. 1). Its a cactus-like plant having green, knife formed plump leaves, tightening, barbed, marinated and loaded up with a reasonable gooey gel as shown in Fig. 1. Aloe vera leaves have a contact angle of 96.89° and subsequently, it has huge wettability. It mostly comprises Ca (3.58 %), Mg (1.22 %), Na (3.66 %), K (4.06 %), P (0.02 %), Fe (0.1 %), Cu (0.06 %), and Zn (0.02 %) [3].

Because Aloe vera leaves contain a variety of bioactive compounds, their use has long been associated with several medical benefits. Injury mending, anticancer, cell reinforcement, immunomodulatory, and purgative are just a few of the detailed qualities. The study of plants reveals the presence of a variety of naturally dynamic mixes that can help with injuries, irritations, malignant growth, diabetes, ulcers, microbiological illnesses, skin diseases, (AIDS), liver harms, dental troubles, cardiovascular problems, hyperlipidemia, and other ailments [4]. In addition, the plant is antagonistic to maturing, purgative, cell reinforcement, and immunomodulatory activities. It also has an effect on oestrogen levels and cell digestion, as well as diuretic exercises. Anticancer, antioxidant, antibacterial, antiallergic, anti-inflammatory, hepatoprotective, antiulcer, and antidiabetic are only a few of the properties of aloe. The gel is used as a substantial component of some corrective definitions, despite its therapeutic characteristics. However, just a few papers have mentioned anthraquinones' results, which are minor when compared to their therapeutic properties [5]. Furthermore, the cosmetic industry could not overlook Aloe vera gel's hydrating and skin-soothing properties. Aloe vera is found in products including soaps and cleansers, sunscreens, face antiaging treatments, lotions, and tissue paper coatings in concen-

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https://doi.org/10.1016/j.matpr.2023.01.393
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the Second Global Conference on Recent Advances in Sustainable Materials 2022.

Renewable Energy Focus 43 (2022) 239–245

Contents lists available at ScienceDirect

Renewable Energy Focus

journal homepage: www.elsevier.com/locate/ref

Application of NSGA-II for environmental constraint economic dispatch of thermal-wind-solar power system

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ARTICLE INFO

Article history:
Received 9 September 2019
Revised 23 April 2020
Accepted 26 August 2022
Available online 18 October 2022

Keywords:
Wind power uncertainty
Solar PV plant
Battery energy storage system
Fuel price
NO_x emission level
SO_2 emission level

ABSTRACT

Economic environmental dispatch (EED) of a thermal-wind-solar power system with battery energy storage system is a significant chore in electric power plant operation that involves allocation of generation among the online units so that the price, NO_x extraction level and SO_2 extraction level are enhanced concurrently whilst gratifying each and every experimental constraint. In the current research, Nondominated Sorting Genetic Algorithm-II (NSGA-II) has been suggested for solving EED problem. The experimental results of the two test systems obtained from the proposed technique for EED have been fit to that acquired from Strength Pareto Evolutionary Algorithm 2 (SPEA 2).

Introduction

Most electrical energy is produced by burning fossil fuels nowadays which releases various pollutants like oxides of sulfur (SO_2), Nitrogen oxides (NO_x), oxides of carbon (CO,CO_2) etc into the air. One of the principles defies for electric utilities is to decrease air contamination. The act proposed in the year 1990 related to Clean Air is planned to diminish global warming. It necessitates that the conventional generation units ought to the above mentioned pollutants spread dimension [1].

More than one method has been projected in the writing to cut down the pollution of natural contamination [2]. This considers the installation of switching device that maintains the emission level, utilization of low emanation raw materials, and replacement of the old combustion chamber through new models and get away with outflow thought [3–4]. These preliminary methods either call for the setting up of latest equipments or alteration of the existing equipments that involves significant funds disbursement. Therefore, the last method is more recommended. Diverse techniques [5–7] have been discussed related to the Economic Emission Dispatch (EED) problem. However, these techniques cannot handle the non-linear fuel cost and emission level functions. Therefore, the last method is more recommended.

The three aims - price, NO_x extraction and SO_2 extraction are contradictory in nature and for discovering overall optimal dispatch they have to be considered concurrently. For arranging the on line generator productivity having the expected load requirement for getting most effective result in terms of price, NO_x extraction and SO_2 extraction at the same time while satisfying each and every operational constraint the Economic environmental dispatch (EED) has been used.

Several methods related to EED problem are discussed in the text. The EED as a multiple, contradictory intentional issue & used goal-programming methods to resolve the non linear problem [8–9]. Optimization procedure based upon linear programming are discussed in [10–11] where the objectives are regarded one by one. Numerous investigations were done to assess the development of multi-objective evolutionary search strategies throughout the previous couple of years. Strength Pareto Evolutionary Algorithm (SPEA 2) [12], Non-Dominating Sorting Genetic Algorithm II (NSGA II) [13], Multi-Objective Evolutionary Algorithm (MOEA) [14] etc., comprise evolving multi-purpose techniques which are pertained towards solving the EED issues.

In the previous ten years, the EED issue was changed into an issue with single target through linear combining of differing points as a weighted entirety [15]. It necessitates through changing weights to acquire a bunch of non-subservient answer. Regrettably, in case of problems with non-convex Pareto-optimal front it is of no use. However, the stochastic search algorithms are very faster and accurate [16–17].

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https://doi.org/10.1016/j.ref.2022.08.008
1755-0084/