Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

6.7 No. of Paper Published

6.7 .1 UGC Care List Journals

6.7 .2 Non-UGC Care List Journals
6.7 .3 Citations

Faculty Profile & Research Activities			
No. of Paper Published			
S. No.	Name of the Faculty	Title of the Paper	UGC / Non-UGC/Citations
1	Dr. Gulshan Mahajan	Effect of Hyperon–Meson Coupling Parameter on Keplerian Frequency of Compact Star	
2	Dr. Gulshan Mahajan	Exploring the Role of Hyperons in Neutron Star Physics Using a Relativistic Mean Field Approach	
3	Dr. Ruchi	On Consecutive Odd Natural Number Matrix	UGC
4	Dr. Kulbhushan & Anupama Sharma	Exploring Caste and Narrative Perspective in Bama's Karukku: A Critique of Social Inequality	UGC
5	Renuka	Intermolecular Cluster Dynamics and Quantum Insights of Lithium Perchlorate in Deep Eutectic Solvent (DES) Solutions with Varying Ratios for Energy Storage Applications	UGC
6	Renuka	Effect of Deep Eutectic Solvent (DES) on Physicochemical and Electrochemical Properties of Diethylmethylammonium Carbonate and Glycolate in Propylene Carbonate and Aqueous Propylene Carbonate Solvent Systems for Energy Storage Applications: A Comparative Analysis	UGC
7	Renuka	Effect of Pyrrolidinium-Based Ionic Liquid on Thermophysical and Electrochemical Properties of Binary Aqueous Solutions of Benzylamine and Benzamide at Different Equidistant Temperatures	UGC
8	Renuka	Unravelling the Prospects of Electrolytes Containing Ionic Liquids and Deep Eutectic Solvents for Next-Generation Lithium Batteries	UGC

9	Dr Virender	Exploring the Role of Hyperons in Neutron Star Physics Using a Relativistic Mean Field Approach	

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Effect of hyperon meson coupling parameter on keplerian frequency of compact star

Gulshan Mahajan[1],* Raj Kumar[2], and Shashi K Dhiman[2]
[1] *Government College Karsog, Dist. Mandi Himachal Pradesh-175011 and*
[2] *Department of Physics, Himachal Pradesh University Shimla-175011*

Introduction

A protoneutron star (PNS) is a result of gravitational collapse of a massive stellar core. Initially it has large radius(∼ 100 Km) and also large temperature which may vary from 50-100 MeV. The process of deleptonization transforms it, into a hot compact star (CS) of T ∼ 10 MeV [1–4]. It is now a well known fact that rotation and temperature of a star increases the equatorial radius and also its mass that can be sustained at a given central energy density [5–7]. The mass shedding limit of a rotating star will be different than cold CS because of increased radius. The properties of the compact stars are mainly determined by the equation of state(EOS) of nuclear dense matter, which is charge neutral matter in β-equilibrium [8]. The discovery of the massive neutron star PSR J1614-2230 (M= 1.97 $\pm 0.04 M_{\odot}$) [9], J0740+6620 (M= 1.14$^{+0.20}_{-0.18} M_{\odot}$) [10], J0348+0432 (M=2.01 $\pm 0.04 M_{\odot}$) [11] etc has questioned the existing models as no relativistic model assuming hyperons in its core predicts mass nearing this. [12–13]. Some of the models produces stars with maximum masses larger than $2M_{\odot}$ assuming strong hyperon vector repulsion [7, 15–21]. In present work we have investigated the role of hyperon vector repulsion on the keplerian frequency of the star. The Lagrangian density for the extended relativistic mean field(ERMF) model describes the interactions from self and mixed terms for the scalar-isoscalar (σ), vector-isoscalar (ω), and vector-isovector (ρ) mesons are explained in reference Further, the hyperon-meson coupling parameters are expressed in terms of the nucleon-meson coupling using the SU(6) model. The coupling parameters of σ-meson-hyperon and ω-meson-hyperon are very sensitive to structural properties of compact stars, so these parameters have been fitted to the hyperon-nucleon potential depth the same as in Ref. [17], and its value $X_{\omega y}$ varies from 0.5 to 0.7, where $X_{\omega y}$ is defined as,

$$X_{\omega Y} = \begin{cases} \left(\frac{g_{\omega Y}}{g_{\omega N}}\right) & for \quad \Lambda \quad and \ \Sigma \ hyperons \\ 2\left(\frac{g_{\omega Y}}{g_{\omega N}}\right) & for \quad \Xi \quad hyperons. \end{cases} \quad (1)$$

where $g_{\omega Y}$ and $g_{\omega N}$ are the ω- meson-hyperon and ω-meson-nucleon coupling parameters [17, 22]. We have used the RNS code for calculating the keplerian frequency of different EOS.

Result and discussion

We calculated the keplerian frequency value for different EOS of ERMF model generated by varying the ω meson self-coupling ζ and neutron skin thickness Δr for the ^{208}Pb nucleus [17] by putting the value of $X_{\omega y}$ as 50, 60 and 70 at various temperatures. We found that the keplerian frequency for cold matter EOS increases as we increase the value of $X_{\omega y}$ from 50 to 70. Further for cold matter EOS the keplerian frequency decreases as we increase the neutron skin thickness Δr from 0.16 to 0.28. The difference Δf_k of keplerian frequency f_k at Δr = 0.16 and Δr = 0.28 increases on increasing the hyperon-meson coupling parameters $X_{\omega y}$. It is further observed that if we fix the value of $X_{\omega y}$ the value of Δf_k increases on increase of ζ parameter.
It is further found that these results reverses for the EOS at finite temperature. We verified these results at a temperature of 5 MeV and 10

*Electronic address: gul.mahajan@gmail.com

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Exploring the role of hyperons in neutron star physics using a relativistic mean field approach

Mukul Kumar[1,*] Virender Thakur[2], Gulshan Mahajan[2,†] Raj Kumar[1,‡] and Shashi K. Dhiman[1]
[1]*Department of Physics, Himachal Pradesh University, Summer Hill, Shimla-171005, INDIA and*
[2]*Department of Physics, Government College Karsog District Mandi, Himachal Pradesh-175011, INDIA*

Introduction

Neutron stars, among the most compact objects in the universe, offer a unique environment to study the behaviour of strongly interacting matter under extreme conditions. These stars contain matter at densities far beyond the nuclear saturation density, reaching up to five to ten times that of normal nuclear matter density. At such extreme densities, new and exotic particles, such as hyperons (baryons containing strange quarks) are expected to form. This is because the Fermi energy of nucleons increases to the point where it becomes energetically favourable for hyperons to appear, as their rest mass energy is comparable to the Fermi energy of the nucleons, which can happen at densities around (2-3) times saturation density of ordinary nuclear matter. The introduction of hyperons into neutron star matter has profound effects on the star's properties, particularly through the equation of state (EoS), which describes the relationship between energy density and pressure. When hyperons appear, they tend to soften the EoS, reducing the internal pressure for a given density. This softening directly impacts the maximum mass that a neutron star can support, leading to a reduction in the predicted maximum mass. This phenomenon is referred to as the " hyperon puzzle " first introduced in 1960 [1]. The puzzle arises because, while the inclusion of hyperons in theoretical models seem natural at high densities, many observations of neutron stars suggest maximum masses that exceed the predictions of such softened equations of state.

In this work, we have employed the HPU's (named after Himachal Pradesh University) [2] parametrizations within the framework of RMF model, which includes β-equilibrated matter composed of nucleons only, and extended it to a model that also includes hyperons. This allows us to investigate the effect of hyperons on the EoS and their role in neutron star structure, especially in terms of their influence on the maximum mass.

Theoretical model

The effective Lagrangian density for the RMF model $\mathcal{L}_{RMF}$, describes the interaction of nucleons through the exchange of σ, ω, and ρ mesons, with interactions considered up to quartic order. The detailed form of this Lagrangian can be found in [2]. In order to extend this formalism to include hyperons, the sum in the Lagrangian must be taken over the complete baryon octet, which consists of nucleons (protons and neutrons) as well as hyperons (Λ, Σ, and Ξ) [3]. To account for hyperon-hyperon interactions, two additional meson fields σ^* (a scalar meson) and ϕ (a vector meson) are introduced. These mesons mediate the interactions between hyperons, providing a more complete description of the forces at play in high-density environments where hyperons are present. The corresponding Lagrangian for the hyperon sector, $\mathcal{L}_Y$ ($Y = \Lambda, \Sigma, \Xi$), can be written as:

$$\mathcal{L}_Y = \sum_Y \overline{\Psi}_Y (g_{\sigma^* Y}\sigma^* - g_{\phi Y}\gamma^\mu \phi_\mu)\Psi_Y + \frac{1}{2}(\partial_\mu \sigma^* \partial^\mu \sigma^* - m_{\sigma^*}^2 \sigma^{*2}) - \frac{1}{4}\phi_{\mu\nu}\phi^{\mu\nu} + \frac{1}{2}m_\phi^2 \phi_\mu \phi^\mu \quad (1)$$

Thus the total Lagrangian density for the model consisting of complete baryon octet can be written as

$$\mathcal{L} = \mathcal{L}_{RMF} + \mathcal{L}_Y \quad (2)$$

The hyperon-meson couplings g_{iY} ($i = \sigma, \omega, \rho$) in the respected Lagrangian can be expressed in terms of nucleon-meson couplings using the SU(6) model [3]. The values used for couplings ($g_{\omega Y}$, $g_{\rho Y}$, $g_{\sigma^*\Lambda}$, $g_{\phi N}$) can be found in [3] and for $g_{\sigma^* Y}$ in [4] respectively. For determining the remaining values of coupling constants ($g_{\sigma Y}$, $g_{\omega Y}$) the expression for potential depth for a given hyperon species in the nuclear matter at saturation density (ρ_0) can be used

$$U_Y^{(N)} = -g_{\sigma Y}\sigma(\rho_0) + g_{\omega Y}\omega(\rho_0) \quad (3)$$

---

*Electronic address: mukulpathania12498@gmail.com
†Electronic address: gul.mahajan@gmail.com
‡Electronic address: raj.phy@gmail.com

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

AIP Conference Proceedings

RESEARCH ARTICLE | APRIL 07 2025

On consecutive odd natural number rhotrix

Shalini Gupta; Ruchi Narang; Neetu Dhiman

AIP Conf. Proc. 3283, 030001 (2025)
https://doi.org/10.1063/5.0265063

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

THE EXPRESSION
An International Multidisciplinary e-Journal
Bimonthly Refereed & Indexed Open Access e-Journal
The Expression Journal
Impact Factor 6.4
Vol. 11 Issue 1 February 2025
Editor-in-Chief : Dr. Bijender Singh
Email : editor@expressionjournal.com
www.expressionjournal.com

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

INTERNATIONAL JOURNAL OF RESEARCH CULTURE SOCIETY

ISSN (O) : 2456-6683

Monthly Peer-Reviewed, Refereed, Indexed Research Journal

Internationally approved Scientific Journal

Impact Factor: 9.241 UGC Journal No: 64291

IJRCS

5th International Conference On Global Trends in English Language, Literature and Linguistics

Date: 14 - 16 February, 2025

DOIs:10.2017/IJRCS/ICGTELLL-2025

Conference Special Issue - 39 February - 2025

Organized & Supported by:

International Languages Council
P.G. Department of English, Panchayat College, Bargarh,
(Affiliated to Sambalpur University, Odisha, India)
Research Culture Society
English Literature Club

RESEARCH CULTURE SOCIETY & PUBLICATION

Email: editorijrcs@gmail.com

Web Email: editor@ijrcs.org

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

ICGTELLL-2025/A11	Rhetoric: The Attractive Artistry of Language -- Dr Neelam Narayan	71-79
ICGTELLL-2025/A12	Using ICT to Teach English Listening and Speaking Skills to Marathi Medium Students -- Sehnaz Khushrow Irani, Dr. Rani Sarode	80-82
ICGTELLL-2025/A13	Linguistic challenges in Amitav Ghosh's the nutmeg's curse: Parables for a planet in crisis -- V. Kavitha	83-85
ICGTELLL-2025/A14	Coloniality and Environment: Subaltern Ecologies in Contemporary North-Eastern Literature. -- Ritesh Kumar Tewary	86-92
ICGTELLL-2025/A15	The Arrow of Justice: Unraveling Adivasi Struggles in Chotti Munda and His Arrow -- Dr. Devyani Singh, Baneshwar Gorain	93-98
ICGTELLL-2025/A16	Reimagining Indianness: Echoes of Bhagavad Gita in Milton's Paradise Lost -- Soyam Prabha Sahoo	99-103
ICGTELLL-2025/A17	Exploring Caste and Narrative Perspective in Premchand's Deliverance: A Critique of Social Inequality -- Dr. Kulbhushan Sharma, Anupama Sharma	104-108
ICGTELLL-2025/A18	Memory, Intergenerational Conflict, and Silent Resistance: The Study of Colonial Trauma and Nation-Building in Tsitsi Dangarembga's "Nervous Conditions" -- Ms. Sudipta Chaki	109-114
ICGTELLL-2025/A19	Voices of Resistance: Gender Identity and Power Dynamics in The Testaments by Margaret Atwood -- Dr. Paramita Bhaduli	115-121
ICGTELLL-2025/A20	To Hail Humanity Rectification Of Religious Customs (Sati Pratha & Johar) -- Dr Neelam Narayan	122-130
ICGTELLL-2025/A21	Congruence of Greek and Indian Myths Unfolded through Epic Study -- Dr. R. Vidyavathi	131-133
ICGTELLL-2025/A22	Mothers, Daughters, and the Sea: A Feminist Reading of Karuthamma and Chakki in Chemmeen -- M Lakshmi Narasimha, P Chitti Babu	134-137
ICGTELLL-2025/A23	Corpus linguistics and its applications in English language teaching. -- Dr. Sheeba Sardar Ali	138-141
ICGTELLL-2025/A24	Sita's Uncharted Odyssey: Echoes of Independence in "The Forest of Enchantments" by Chitra Banerjee Divakaruni -- Rashmi [illegible]	142-146

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Exploring Caste and Narrative Perspective in Premchand's 'Deliverance': A Critique of Social Inequality

[1]**Dr. Kulbhushan Sharma,** [2]**Anupama Sharma**
[1,2]Assistant Professor of English
Government College Karsog, District Mandi (HP),
Email- 1kaybee24.rj@gmail.com, 2anupamakh26@gmail.com

Abstract: *The present paper explores the portrayal of caste discrimination in Premchand's short story* "Deliverance"*, highlighting its critique of the entrenched caste system in pre-Independence India. The narrative follows Dhuki, a low-caste shoemaker, who, despite the oppressive social norms of untouchability, must seek a marriage date for his daughter from the high-caste priest, Pandit Ghasiram. Through this interaction, the story illustrates the exploitation of lower-caste individuals by higher-caste oppressors and critiques the moral contradictions within the caste system. The paper examines the question of narrative perspective, asking whether a victim, an oppressor, or a detached third-party narrator would best illuminate such social issues. Furthermore, it questions the ability of a non-Dalit writer, such as Premchand, to authentically represent Dalit experiences. By analysing Premchand's characterisation and themes, the paper probes the broader socio-cultural rifts in pre-Independence India and the effectiveness of literary interventions by humanist writers in addressing caste-based oppression. It also investigates whether such narratives can still foster social change in contemporary India, where casteism persists despite legal progress. The paper contends that Premchand's work remains a critical tool for understanding caste discrimination, while raising ongoing questions about the authenticity and responsibility of representing marginalised voices in literature.*

Keywords: *Dalit, Casteism, Oppression, Narrative Perspective, Social Change.*

INTRODUCTION:

Premchand's short story 'Sadgati' (Deliverance) is a poignant critique of the socio-economic inequalities and the oppressive caste system prevalent in early 20th-century India. This analytical article dissects the layers of meaning within the narrative, examining the themes of class, caste, and human dignity. Through the lens of literary analysis, the work explores how Premchand exposes the moral decay wrought by societal structures and highlights the tragic futility of existence for marginalized individuals. By invoking a strong sense of realism characteristic of his work, Premchand compels readers to confront uncomfortable truths about the human condition.

Premchand is one of the most distinguished writers in Hindi and Urdu literature, acclaimed for his ability to depict the harsh realities of life, especially those surrounding social issues. His short story 'Sadgati' (Deliverance) serves not only as a narrative of individual suffering but also as a critical exploration of social inequities entrenched in the caste system. This tale, set in a rural village, draws attention to the pervasive nature of caste discrimination, the indifference of those in power, and the endurance of the oppressed. The present article aims to provide an in-depth analysis of the intricacies of caste depicted in 'Sadgati,' through a critical lens that foregrounds narration, characterisation, and the broader implications of Premchand's critique of social injustice. Ambedkar discussed the principles

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Exploring the role of hyperons in neutron star physics using a relativistic mean field approach

Mukul Kumar[1,*] Virender Thakur[2], Gulshan Mahajan[2,†] Raj Kumar[1,‡] and Shashi K. Dhiman[1]
[1]*Department of Physics, Himachal Pradesh University, Summer-Hill, Shimla-171005, INDIA and*
[2]*Department of Physics, Government College Karsog District Mandi, Himachal Pradesh-175011, INDIA*

Introduction

Neutron stars, among the most compact objects in the universe, offer a unique environment to study the behaviour of strongly interacting matter under extreme conditions. These stars contain matter at densities far beyond the nuclear saturation density, reaching up to five to ten times that of normal nuclear matter density. At such extreme densities, new and exotic particles, such as hyperons (baryons containing strange quarks) are expected to form. This is because the Fermi energy of nucleons increases to the point where it becomes energetically favourable for hyperons to appear, as their rest mass energy is comparable to the Fermi energy of the nucleons, which can happen at densities around (2-3) times saturation density of ordinary nuclear matter. The introduction of hyperons into neutron star matter has profound effects on the star's properties, particularly through the equation of state (EoS), which describes the relationship between energy density and pressure. When hyperons appear, they tend to soften the EoS, reducing the internal pressure for a given density. This softening directly impacts the maximum mass that a neutron star can support, leading to a reduction in the predicted maximum mass. This phenomenon is referred to as the " hyperon puzzle " first introduced in 1960 [1]. The puzzle arises because, while the inclusion of hyperons in theoretical models seem natural at high densities, many observations of neutron stars suggest maximum masses that exceed the predictions of such softened equations of state.

In this work, we have employed the HPU's (named after Himachal Pradesh University) [2] parametrizations within the framework of RMF model, which includes β-equilibrated matter composed of nucleons only, and extended it to a model that also includes hyperons. This allows us to investigate the effect of hyperons on the EoS and their role in neutron star structure, especially in terms of their influence on the maximum mass.

Theoretical model

The effective Lagrangian density for the RMF model $\mathcal{L}_{RMF}$, describes the interaction of nucleons through the exchange of σ, ω, and ρ mesons, with interactions considered up to quartic order. The detailed form of this Lagrangian can be found in [2]. In order to extend this formalism to include hyperons, the sum in the Lagrangian must be taken over the complete baryon octet, which consists of nucleons (protons and neutrons) as well as hyperons (Λ, Σ, and Ξ) [3]. To account for hyperon-hyperon interactions, two additional meson fields σ^* (a scalar meson) and ϕ (a vector meson) are introduced. These mesons mediate the interactions between hyperons, providing a more complete description of the forces at play in high-density environments where hyperons are present. The corresponding Lagrangian for the hyperon sector, $\mathcal{L}_Y$ ($Y = \Lambda, \Sigma, \Xi$), can be written as:

$$\mathcal{L}_Y = \sum_Y \overline{\Psi}_Y (g_{\sigma^* Y}\sigma^* - g_{\phi Y}\gamma^\mu \phi_\mu)\Psi_Y + \frac{1}{2}(\partial_\mu\sigma^*\partial^\mu\sigma^* - m_{\sigma^*}^2\sigma^{*2}) - \frac{1}{4}S_{\mu\nu}S^{\mu\nu} + \frac{1}{2}m_\phi^2\phi_\mu\phi^\mu \qquad (1)$$

Thus the total Lagrangian density for the model consisting of complete baryon octet can be written as

$$\mathcal{L} = \mathcal{L}_{RMF} + \mathcal{L}_Y \qquad (2)$$

The hyperons-meson couplings g_{iY} ($i = \sigma, \omega, \rho$) in the respected Lagrangian can be expressed in terms of nucleons-mesons couplings using the SU(6) model [3]. The values used for couplings ($g_{\omega Y}$, $g_{\rho Y}$, $g_{\phi Y}$) can be found in [3] and for $g_{\sigma^* Y}$ in [4] respectively. For determining the remaining values of coupling constants ($g_{\sigma Y}$, $g_{\omega Y}$) the expression for potential depth for a given hyperon species in the nuclear matter at saturation density (ρ_0) can be used.

$$U_Y^{(N)} = -g_{\sigma Y}\sigma(\rho_0) + g_{\omega Y}\omega(\rho_0) \qquad (3)$$

---

*Electronic address: mukulpathania12898@gmail.com
†Electronic address: gul.mahajan@gmail.com
‡Electronic address: raj.phy@gmail.com

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Volume 171, June 2025, 106041

Intermolecular dynamics and quantum insight of lithium perchlorate in the deep eutectic solvent (DES) solutions with nitriles for energy storage applications

Akshay Sharma, Renuka Sharma, Ramesh Chand Thakur

https://doi.org/10.1016/j.jtice.2025.106041

Highlights

- Volumetric and acoustic studies reveal structural interactions.
- DFT analysis provides insights, highlighting system stability and interactions.
- Electrochemical parameters validate the DES system's capability as an electrolyte.
- FTIR spectroscopy highlights structural analysis in the DES–lithium–nitrile system.

Abstract

Background

Deep eutectic solvents (DESs) in combination with lithium salts are evolving as promising alternative electrolytes for energy storage applications. However, to efficiently develop, produce, and improve DES-based electrolytes, a thorough understanding of the various interactions involved, is essential for elucidating the intermolecular dynamics among all components in the systems.

Methods

We used a combination of experimental thermodynamic techniques, including density and speed of sound measurements, to investigate the physicochemical properties of ethaline DESs with nitriles (acetonitrile and succinonitrile) and lithium salt ($LiClO_4$). Electrochemical stability, conductivity, and FTIR spectroscopy were employed to explore electrochemical properties and molecular interactions. Computational studies, including optimized structure calculations, interaction energy analysis, and reduced density gradient (RDG) studies, were performed to assess the stability and bonding interactions in these systems.

Significant findings

Our results reveal strong solute–solvent interactions, particularly with increasing $LiClO_4$ and nitrile concentrations. Temperature derivatives showed that $LiClO_4$ influences solution structure, acting as a disruptor. FTIR analysis confirmed key hydrogen bonding interactions. Electrochemical studies demonstrated enhanced conductivity, while computational studies supported

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Journal of Molecular Liquids
Volume 416, Part B, 15 December 2024, 126494

Effect of Deep Eutectic Solvent (DES) on physicochemical and electrochemical properties of triethylmethylammonium tetrafluoroborate in propylene carbonate and aqueous propylene carbonate solvent systems for energy storage applications: A comparative analysis

Renuka Sharma, Akshay Sharma, Ramesh Chand Thakur

https://doi.org/10.1016/j.molliq.2024.126494

Highlights

- Comparative thermo physical and electrochemical study of $TEMABF_4$ in different binary and ternary systems.
- $TEMABF_4$ behaved as a structure maker in DES + aqueous PC system and structure breaker in DES+PC system.
- DES enhanced the solute–solvent interactions in DES+PC system and H-bonding was found between water and DES in DES + aq. PC system.
- CV and conductance study to validate electrochemical properties respectively.

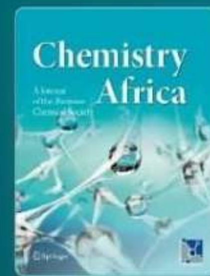
Abstract

The use of non-toxic and biodegradable Deep Eutectic Solvents (DES) in energy storage has attracted a lot of attention as the toxic, costly and flammable organic electrolytes do not seem to be sustainable for the environment. So, to analyse the potential of DESs in this area their physicochemical properties and molecular interaction study can be quite helpful. The measurements were made of the density, sound speed, and electrical conductivity of Triethylmethylammonium Tetrafluoroborate ($TEMABF_4$) at four different temperatures in two different solvent systems: propylene carbonate (PC) with ethaline DES (a mixture of ethylene glycol and chlorine in a 1:2 ratio) added as an additive, and binary aqueous PC with ethaline DES again, added as an additive. Density and speed of sound measurements were used to determine the physicochemical characteristics such as apparent molar volume and partial molar volume), apparent molar isentropic compressibility and partial molar isentropic compressibility and limiting molar expansibilities. The effects of DES on the intermolecular interactions in the PC and aqueous PC solvent environment were demonstrated using these parameters. The findings

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Effect of Pyrrolidinium Based Ionic Liquid on Thermo Physical and Electrochemical Properties of Binary Aqueous Solutions of Benzylamine and Benzamide at Different Equidistant Temperatures (288.15 K to 318.15 K)

Original Article | Published: 17 November 2024
Volume 7, pages 5641–5658, (2024) Cite this article



Nidhi, Ramesh Chand Thakur, Ashish Kumar, Praveen Kumar Sharma, Akshay Sharma, Renuka Sharma, Nancy George & Jandeep Singh

Abstract

Effect of pyrrolidinium-based ionic liquid (IL) (1-butyl-1-methyl pyrrolidinium iodide) on the volumetric, acoustic and electrochemical properties of aqua solutions of benzylamine and benzamide has been analyzed at equidistant temperature range (288.15 K to 318.15 K) using different techniques. Density (ρ) and sound speed (u) for five different molal compositions (0.001 mol kg^{-1} to 0.009 mol kg^{-1}) of the IL has been measured in binary aqua solutions of benzyl amine and benzamide. Using the measured density and sound velocity data, volumetric and acoustic quantities viz., AMV (apparent molar volume, V_ϕ), PMV (partial molar volumes, V_ϕ^0), standard partial molar volume of transfer (ΔV_ϕ^0), partial molar isentropic compression ($K_{\phi,s}^0$), apparent molar isentropic compression ($K_{\phi,S}$), and partial molar isentropic compression of transfer ($K_{\phi,s}^0$) have been calculated. Transfer parameters were also determined and further used for the computation of pair and triplet interaction coefficients. The ion–solvent interactions have also been analyzed from conductance studies. Cyclic Voltammetry (CV) studies were further performed to investigate the electrochemical properties of the ternary mixtures for exploring their applications in different energy storage devices. The experimental results were also used to predict the structural behavior of the IL in aqueous benzylamine/benzamide solutions. Additionally, FTIR (Fourier Transformation Infrared Spectroscopy) and DFT (Density Functional Theory) techniques using (B3LYP)/6-311G++ (d, p) basis set of hybrid density functional theory was applied to the optimized geometrical structure of the ionic liquid using the Gaussian 09 program.

Government College, Karsog
District Mandi (HP)-175011
Telephone/ Fax no. 01907-222116
E-mail: gckarsog-hp@.nic.in
Website: www.gckarsog.edu.in

Journal of Energy Chemistry 105 (2025) 482–500

Contents lists available at ScienceDirect

Journal of Energy Chemistry

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

Review

Unravelling the prospects of electrolytes containing ionic liquids and deep eutectic solvents for next generation lithium batteries

Shivani, Ramesh Chand Thakur *, Akhil Thakur, Akshay Sharma, Renuka Sharma

Department of Chemistry, Himachal Pradesh University, Summer Hill, Shimla 171005, Himachal Pradesh, India

ARTICLE INFO

Article history:
Received 17 December 2024
Revised 24 January 2025
Accepted 31 January 2025
Available online 20 February 2025

Keywords:
Electrolytes
Deep eutectic solvents
Ionic liquids
Lithium salts
Electrochemical performance
Lithium batteries

ABSTRACT

The rising need for efficient and sustainable energy storage systems has led to increased interest in the use of advanced electrolytes consisting of deep eutectic solvents (DESs) and ionic liquids (ILs). These electrolytes are appealing candidates for supercapacitors, next-generation lithium-ion batteries, and different energy storage systems because of their special features including non-flammability, low volatility, low-toxicity, good electrochemical stability, and good thermal and chemical stability. This review explores the advantages of the proposed electrolytes by examining their potential to address the critical challenges in lithium battery technology, including safety concerns, energy density limitations, and operational stability. To achieve this, a comprehensive overview of the lithium salts commonly employed in rechargeable lithium battery electrolytes is presented. Moreover, key physicochemical and functional attributes of ILs and DESs, such as electrochemical stability, ionic conductivity, nonflammability, and viscosity are also discussed with a focus on how these features impact battery performance. The integration of lithium salts with ILs and DESs in modern lithium battery technologies, including lithium-ion (Li-ion) batteries, lithium-oxygen (Li-O_2) batteries, and lithium-sulfur (Li-S) batteries, are further examined in the study. Various electrochemical performance metrics including cycling stability, charge/discharge profiles, retention capacity and battery's coulombic efficiency (CE) are also analyzed for the above-mentioned systems. By summarizing recent advances and challenges, this review also highlights the potential of electrolytes consisting of DESs and ILs to enhance energy density, durability, and safety in future energy storage applications. Additionally future research directions, including the molecular optimization of ILs and DESs, optimizing lithium salt compositions, and developing scalable synthesis methods to accelerate their practical implementation in next-generation energy storage applications are also explored.

1. Introduction

The fast advancement and growing need for high-performance, lightweight, and affordable portable electronics, such as those used in electric cars, aeronautics, and healthcare industries, has encouraged researchers to investigate enhanced electrochemical energy storage (EES) technologies [1,2]. In the pursuit of renewable energy options, there is an urgent need for the development of long-lasting, highly effective, high energy-power resources. Different EES systems, including batteries and supercapacitors, have emerged as appealing candidates to meet these demands. Batteries shine with their high energy density and high-rate capability, whereas supercapacitors provide advantages such as quick charge-discharge rates, high power output, and extended cycle life [3,4]. A civilization that can rely on renewable energy will be able to shift away from its reliance on fossil fuels towards the effective integration of renewable energy sources, including hydropower, wind, and solar, with EES systems, especially batteries [5]. Worldwide interest has been drawn in rechargeable lithium batteries owing to their potential as sustainable energy storage systems. These include solid state lithium batteries with solid state electrolyte, lithium oxygen (Li-O_2) batteries, lithium sulfur (Li-S) batteries with sulfur composite cathode, emerging lithium metal batteries (LMBs) with intercalation-type cathode, and standard lithium-ion batteries (LIBs) [6,7]. Since their inception in 1991, lithium-ion (Li-ion) batteries are regarded as one of the most intriguing EES technologies among the numerous types of rechargeable batteries. To store energy in Li-ion batteries, lithium

* Corresponding author.
E-mail address: drthakurchem@gmail.com (R.C. Thakur).

https://doi.org/10.1016/j.jechem.2025.01.060
2095-4956/