# RESEARCH

# 2018-2019

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## Title of the collaborative activity : Paper Publication

# Structural and Electrical Characterization of Tamarind Seed Polysaccharide (TSP) doped with $NH_4HCO_2$

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**Abstract.** In the modern era, development of electrochemical energy devices such as batteries, fuel cells and supercapacitors gain attention due to the deficiency of renewable energy resources. More specifically, proton conducting materials create prime interest in the development of electrochemical devices. In this regards, a novel proton conducting biopolymer electrolyte based on Tamarind Seed Polysaccharide (TSP) was synthesized with different concentration of ammonium formate ($NH_4HCO_2$). The amorphous nature of the polymer electrolytes has been identified by XRD technique. The observed ionic conductivity values reveal that the biopolymer containing 1 g TSP: 0.4 g $NH_4HCO_2$ has highest ionic conductivity $1.23 \times 10^{-3}$ S cm$^{-1}$.

## INTRODUCTION

Energy is essential to our society to ensure our quality of life. It is impossible to imagine modern society without electrochemical power sources. The electrochemical power sources include batteries, fuel cells and super capacitors etc [1]. Polymer electrolyte is an indispensible part of batteries which also acts as a separator. Traditional batteries use liquid electrolytes such as acid or alkali solution. However, a liquid electrolyte impedes its further applications due to leakage, corrosion and internal short circuiting of electrolytes. In that aspect, we require a solid polymer electrolyte to overcome the shortcomings of liquid electrolytes. The main concern for achieving the solid polymer electrolyte is the high ionic conductivity at ambient temperature, good mechanical strength and the ability to form good interfacial contacts with electrodes. The main goal is now produce the polymer electrolyte with the above mentioned required properties. Currently, polysaccharide based biopolymer electrolytes have gathered much attention among the researchers. Polysaccharides are formed by a glycosidic linkage of monosaccharide units. Polysaccharides are more hydrophobic if they have a greater number of internal hydrogen bonds and as their hydrophobicity increases there is less direct interaction with water. The main attractive properties of polysaccharides based biopolymers are their easy film forming nature, good mechanical strength and being environmentally green. There has been plenty of works have been done using biopolymers which have been supported by our literature survey. Shukur et al and Majid et al have developed a proton conducting biopolymer electrolytes based on Starch-chitosan blend chitosan-$NH_4NO_3$ complex respectively [2,3]. Similarly natural polymers such as cellulose and its derivatives [4], pectin [5], carboxy methyl cellulose [6] have been studied extensively by many authors.

Among natural polymers, Tamarind seed polysaccharide (TSP) is a distinct biopolymer having excellent properties such as good gelling agent, easy film forming capacity etc. It is a highly branched anionic polysaccharide with more number of polar groups. To the best of our knowledge, the polymer electrolyte for electrolyte device applications using TSP as host polymer have not been reported except Premalatha et al [7].

The main motive of this paper is to provide the study of a novel proton conducting biopolymer electrolyte based on TSP. Our study shows that, the ionic conductivity of pure TSP is in the order of $10^{-7}$ Scm$^{-1}$ hampers its application in electrochemical devices. However, the ionic conductivity of pure TSP is improved by incorporating different concentration of ammonium formate ($NH_4HCO_2$). Ammonium salts are considered to be a good proton donor to the polymer matrix, since three protons of

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## Title of the collaborative activity : Guest Lecture on "Research Methedology".

தி ஸ்டாண்டர்டு ஃபயர்ஒர்க்ஸ் இராஜரத்தினம் மகளிர் கல்லூரி (தன்னாட்சி)

தமிழ்த்துறை

செய்தி அறிக்கை

சிவகாசி எஸ். எஃப். ஆர். மகளிர் கல்லூரியின் தமிழ்த்துறை சார்பில் 7.12.2018 அன்று ஆய்வு மாணவர்களுக்கு ஆய்வுக்கூட்டம் நடைபெற்றது. இவ்விழாவிற்கு கல்லூரி முதல்வர் டாக்டர் திருமதி நடராஜீஸ்வரி அவர்கள் தலைமையுரை நல்கினார். நிகழ்ச்சியின் தொடக்கமாக எஸ்.எஃப்.ஆர். மகளிர் கல்லூரியின் தமிழ்த்துறை உதவிப்பேராசிரியர் முனைவர்.ப.பொன்னி, அனைவரையும் வரவேற்றார். சிறப்பு விருந்தினர் திருப்பத்தூர் தூய நெஞ்சக்கல்லூரி தமிழ்த்துறைத் தலைவர் முனைவர்.கி.பார்த்திபராஜா அவர்கள் "ஆய்வேடு எழுதும் முறைகள்" குறித்து உரையாடினார். இக்கூட்டத்தில் தமிழ்த்துறையைச் சார்ந்த ஆய்வு மாணவிகள் 40 பேர் கலந்து கொண்டு பயனடைந்தனர்.

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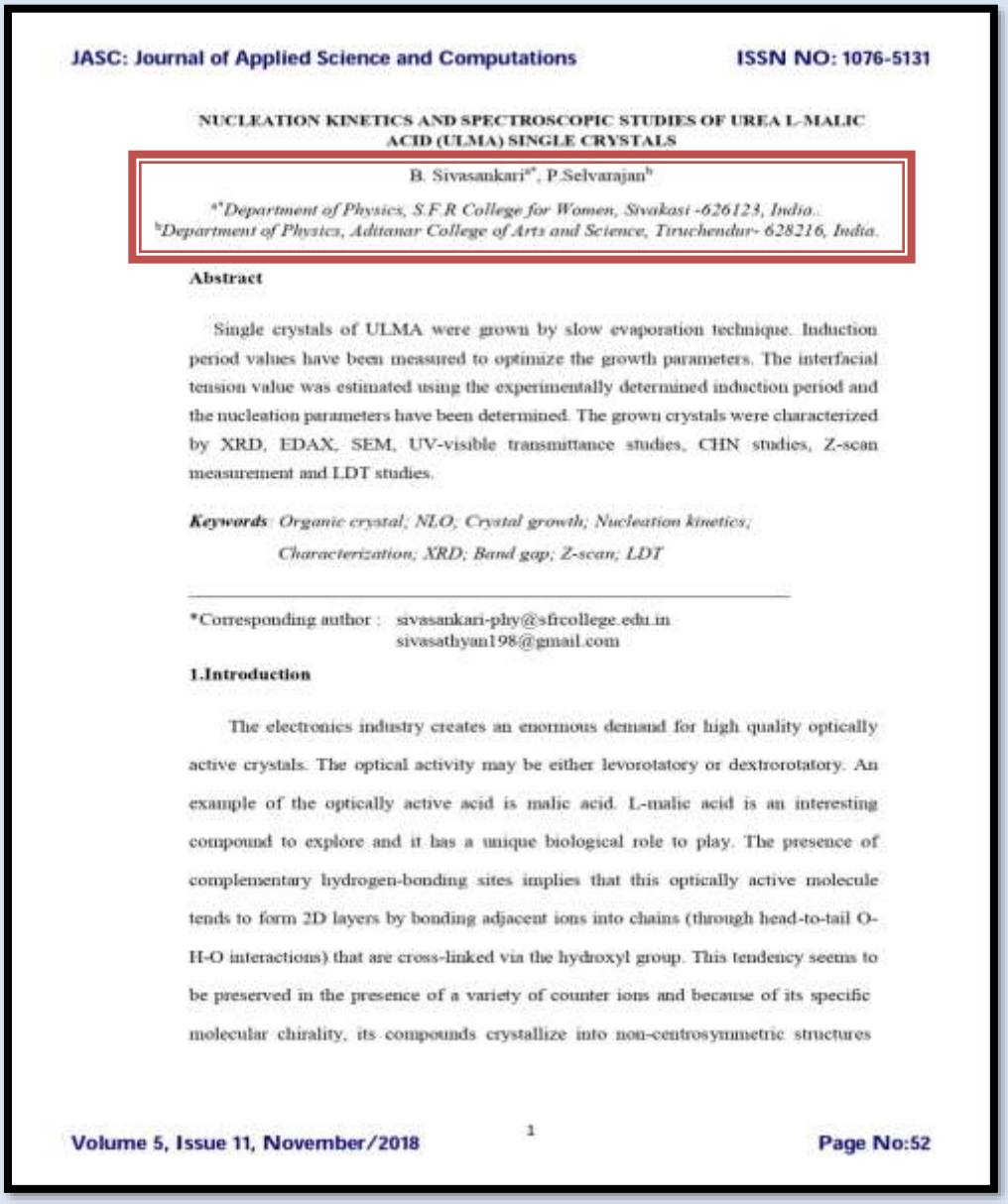
## Title of the collaborative activity : Paper Publication



JASC: Journal of Applied Science and Computations ISSN NO: 1076-5131

# NUCLEATION KINETICS AND SPECTROSCOPIC STUDIES OF UREA L-MALIC ACID (ULMA) SINGLE CRYSTALS

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**Abstract**

Single crystals of ULMA were grown by slow evaporation technique. Induction period values have been measured to optimize the growth parameters. The interfacial tension value was estimated using the experimentally determined induction period and the nucleation parameters have been determined. The grown crystals were characterized by XRD, EDAX, SEM, UV-visible transmittance studies, CHN studies, Z-scan measurement and LDT studies.

***Keywords***: *Organic crystal; NLO; Crystal growth; Nucleation kinetics; Characterization; XRD; Band gap; Z-scan; LDT*

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**1.Introduction**

The electronics industry creates an enormous demand for high quality optically active crystals. The optical activity may be either levorotatory or dextrorotatory. An example of the optically active acid is malic acid. L-malic acid is an interesting compound to explore and it has a unique biological role to play. The presence of complementary hydrogen-bonding sites implies that this optically active molecule tends to form 2D layers by bonding adjacent ions into chains (through head-to-tail O-H-O interactions) that are cross-linked via the hydroxyl group. This tendency seems to be preserved in the presence of a variety of counter ions and because of its specific molecular chirality, its compounds crystallize into non-centrosymmetric structures

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## Title of the collaborative activity : Paper Publication

Journal of Solid State Electrochemistry
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ORIGINAL PAPER

Check for updates

# Characterization of biodegradable solid polymer electrolyte system based on agar-$NH_4Br$ and its comparison with $NH_4I$

S. S[redacted]

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**Abstract**
Concerning the pollution-free and eco-friendly materials, the prospect of using biopolymer as ion conducting matrix has been investigated in this study. Biopolymer electrolyte based on agar with different concentrations of $NH_4Br$ has been prepared by solution casting technique using water as solvent. The prepared electrolytes are characterized by X-ray diffraction analysis, Fourier-transform infrared spectroscopy, AC impedance spectroscopy, and electrochemical stability. X-ray diffraction is done to study the nature (amorphous/crystalline) of the polymer membranes. The complexation of the prepared polymer electrolytes has been studied using Fourier-transform infrared (FTIR) spectroscopy. The maximum ionic conductivity of $1.33 \times 10^{-4}$ S $cm^{-1}$ has been obtained for 50 M.wt% $NH_4Br$ with agar polymer electrolyte. The temperature dependence of ionic conductivity of the prepared polymer electrolytes obeys Arrhenius law. The ionic transference numbers of mobile ions have been estimated by Wagner's dc polarization method and the results reveal that the conducting species are predominantly ions. The electrochemical stability is studied by linear sweep voltammetry. A battery has been constructed using the highest conductivity sample and its output voltage is found to be 1.80 V. A proton-exchange membrane fuel cell fabricated with the 50 M.wt% $NH_4Br$-doped agar polymer electrolyte exhibited an output voltage of 500 mV. These results of 50 M.wt% $NH_4Br$-doped agar have been compared with 50 M.wt% agar:50 M.wt% $NH_4I$ biopolymer electrolyte.

## Introduction

The term "Solid State Ionics" was first coined by Prof. Takehiko Takahashi, Nagoya University in 1970. This science focuses mostly on solid electrolytes in which conduction takes place predominantly due to ions. The seed of the technological achievements in this field has been sowed by the end of nineteenth century by Faraday. A further development has been contributed by Nernst in 1897 with the development of a solid electrolyte stabilized zirconia which was used in Nernst Glower. Hence, with the efforts of the researchers, the sowed seed of this field has flourished with the branches of various types of solid electrolytes such as solid polymer electrolytes (SPEs), crystals, glasses, and biopolymer electrolytes. In recent years, it has bloomed as blossoms with flourishing fragrance in batteries [1, 2], sensors [3, 4], super-capacitors [5], electrochromic displays [6], fuel cells [7], solar cells [8], and other applications.

Owing to the depletion of fossil fuels and growing energy demand, there arises a necessity to find an alternate energy-producing resource which means to be eco-friendly. Recently, biopolymer materials, such as chitosan, corn starch, and carrageenan, have been used extensively as electrolytes [9–11]. S. C. Nunes et al. [12] have reported a conductivity value of $8.47 \times 10^{-4}$ S $cm^{-1}$ at room temperature for κ-carrageenan with 1-butyl-3-methyl-1H-imidazolium chloride ionic liquid and glycerol. Maximum conductivity value of $3.56 \times 10^{-3}$ S $cm^{-1}$ at room temperature for i-carrageenan with ammonium thiocyanate has been reported recently [13]. Biopolymer electrolyte based on tamarind seed polysaccharide and lithium chloride exhibited maximum conductivity of $6.7 \times 10^{-3}$ S $cm^{-1}$ at room temperature [14]. By merely becoming more environmentally aware, agar, a biopolymer, has been chosen

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# Development of Nonlinear Optical (NLO) Crystal L-Phenylalanine Doped Ammonium Dihydrogen Ortho Phosphate (ADOP)

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***Abstract :*** The Amino acid L-Phenylalanine doped with Ammonium Dihydrogen Ortho Phosphate crystal was grown by the slow evaporation method using water as a solvent has been synthesized. The grown crystals were subjected to powder XRD analysis, the peaks confirm the crystalline nature. And the crystal XRD analysis determines the structure and lattice parameters of the crystal. The FTIR analysis shows the functional group of the material components. The AC impedance spectroscopy studies are carried out and the conductivity is measured. The NLO Property of grown L-Phenylalanine doped with Ammonium Dihydrogen Ortho Phosphate was carried out by Nd: YAG Laser.

***Keywords:*** **Crystal growth, NLO, XRD, FT-IR spectrum, AC impedance studies.**

## I. INTRODUCTION

Nonlinear optical materials play a vital role in the field of optics, these NLO material application areas are telecommunications optical signal processing, optical switching, photonics and optoelectronic technology [1-4], because of their applications lots of NLO crystals were grown[5-8]. Already NLO crystals such as L-Phenylalanine Nitrate [5], L-Phenylalanine fumaric acid [10], L-Phenylalanine nitric acid [9], L-Phenylalanine malonate [10], L-Phenylalanine perchlorate [11], L-Phenylalanine [12], and L-Phenylalanine potassium hydrogen phthalate [3] were grown by the researchers.

Phenylalanine is naturally available amino acids in protein; it is an important amino acid. The L-Phenylalanine amino acid is important for the body to create neurotransmitters [5]. The biological importance and naturally occurring properties of L-Phenylalanine have motivated to grow the NLO crystal with L-Phenylalanine. Generally, L-Phenylalanine is soluble in aqueous solution and the molecular formula is C 9H 11NO2 [13]. From the literature, there are no studies on L-Phenylalanine doped with Ammonium dihydrogen orthophosphate. The main purpose of this present work is to grow the NLO crystals based on L-Phenylalanine doped with Ammonium dihydrogen phosphate and characterized by single crystal XRD, Powder XRD, FTIR, and NLO studies by using Nd: YAG Laser.

## II. EXPERIMENTAL DETAILS

Analytical reagent grade [14] of Amino acid L-Phenylalanine and Ammonium salt Ammonium Dihydrogen Ortho Phosphate were mixed in a stoichiometric ratio [15] in distilled water. The resultant solution was filtered and transferred to the crystal growth vessels. Crystallization was allowed to take place by slow evaporation at room temperature [8, 15] for a week in a dust free place. After a week, well defined transparent crystals were obtained as the size of 5mm length. The obtained crystal was carefully removed from the solution. The crystals were allowed to dry for sometime in dust free place. After these colorless transparent crystals were collected and stored in a clean and airtight container. L-Phenylalanine doped Ammonium Dihydrogen Ortho Phosphate crystals the morphology is shown in figure 1.

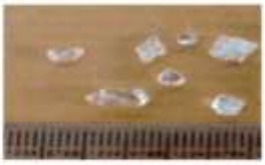

**Fig. 1 Morphology L-Phenylalanine doped Ammonium Dihydrogen Ortho Phosphate single crystals**

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**Title of the collaborative activity : Guest Lecture on Feminist Criticism**

தி ஸ்டாண்டர்டு ஃபயர்ஒர்க்ஸ் இராஜரத்தினம் மகளிர் கல்லூரி, (தன்னாட்சி)
( ஆற்றல்சால் கல்லூரி, தேசியத் தர நிர்ணயக் குழுவின் மறுமதிப்பீட்டில் 'A' தரம் பெற்றது )
சிவகாசி
தமிழ்த்துறை
செய்தி அறிக்கை

சிவகாசி எஸ். எஃப். ஆர். மகளிர் கல்லூரியின் தமிழ்த்துறை சார்பில் 27.02.2019 அன்று கருத்தரங்கம் நடைபெற்றது. இக்கருத்தரங்கில் கல்லூரி முதல்வர். முனைவர் தபழனீஸ்வரி அவர்கள் தலைமையேற்றார். நிகழ்ச்சியின் தொடக்கமாக முதுகலை ஆங்கிலம் இரண்டாம் ஆண்டு பயிலும் மாணவி செல்வி எஸ்.இராஜலட்சுமி அனைவரையும் வரவேற்றார். ஆங்கிலத்துறைத்தலைவர் திருமதிகேமுத்துச்செல்வி அவர்கள் தலைமையுரை ஆற்றினார். பயிலரங்கின் முதல் அமர்வுப் பயிற்றுநர் தமிழ்த்துறை உதவிப்பேராசிரியர் முனைவர் மாபத்மபிரியா அவர்கள் பெண்ணியத்திறனாய்வு குறித்து சிறப்புரையாற்றினார். தடம்பதித்த படைப்பாளர்களது படைப்புக்களில் இடம்பெற்றிருக்கும் கருத்தாக்கங்களை மாணவியர் புரிந்து கொள்ளத்தக்க வகையில் எடுத்துரைத்தார். பெண்ணியத்திறனாய்வின் இலக்கியங்களை ஆய்ந்தறியும் உத்திமுறைகளை சுட்டிக்காட்டினார் . காலந்தோறும் பெண்களுக்கு ஏற்படும் பல்வேறு விதமான சிக்கல்களையும் பெண்ணியச்சிதைவுகளையும் இலக்கியத்தின் வழி ஆய்ந்துரைத்தார். மாணவியர்கள் ஆய்வு உலகில் படைப்புகளை ஆய்ந்தறிவதற்கான ஆய்வுநெறிமுறைகளைச் சுட்டிக்காட்டினார். இந்நிகழ்வில் தமிழ்த்துறையைச் சார்ந்த 80 மாணவிகள் மற்றம் 30 பேராசிரியர்கள் பங்கேற்று பயனடைந்தனர். நிகழ்ச்சியின் நிறைவாக இளநிலை ஆய்வாளர் செல்விநந்தினி நன்றியுரை வழங்கினார்.

ஒருங்கினைப்பாளர்

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