



Surya Sen Mahavidyalaya

Siliguri



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Department of Physics

Impurity level substitution of Cr and Ni in CaBaCo₄O₇ – a dielectric study

Soma Adhikari, Arindam Karmakar, Dept of Physics

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Research Papers

Impurity level substitution of Cr and Ni in CaBaCo₄O₇ – a dielectric study

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ABSTRACT

The fascinating physical characteristics of the 114-cobaltate, CaBaCo₄O₇, like alternate stacking of two-dimensional layers of CoO₄ tetrahedra in triangular and kagomé patterns, geometrical frustration, and magnetoelectric coupling have attracted several studies in the magneto-structural and dielectric sectors. But the study of electrical conduction dynamics remains practically unknown. Here we have presented dc conduction studies and ac dielectric spectroscopy intending to understand the charge conduction and charge carrier relaxation dynamics of CaBaCo₄O₇, along with two chemically substituted derivatives – CaBaCo_{3.98}Cr_{0.02}O₇ and CaBaCo_{3.96}Ni_{0.04}O₇, of impurity level (1%) substitutions. We observe that dc conduction at low temperatures is mediated by variable range polaron hopping, while the ac conduction study points out small-polaron-tunneling across strongly localized states. Electric modulus obeys the Havriliak-Negami equation, with parameters α and γ significantly less than unity, indicating strong distribution in relaxation times; and its non-exponential nature, pointing out the cooperative motion of charge carriers. Imaginary electric modulus is not scaled to a single master curve for the three samples, signifying differences in charge relaxation dynamics.

1. Introduction

During the last two decades, a member series of the cobaltate family called the 114-cobaltates, with the general formula $LnBaCo_4O_7$ (Ln are mainly Lanthanides, Y, and Ca), received a lot of attention due to its intriguing physical properties originating from a unique structure of alternately stacked triangular and kagomé layers of interconnected cobalt tetrahedra along the c -direction [1–5]. The materials were also incidentally found to possess good oxygen absorption and desorption capabilities upon temperature cycling, making them suitable for gas storage and gas sensor applications [6,7]. Besides, the system is a playground of competing magnetic interactions because of geometrical frustration in the kagomé layers and has been the subject of several scientific investigations. Among the series, CaBaCo₄O₇, reported in 2009 [8], revived the excitement again because of its distinctive intense polarization and ferrimagnetic order originating via strong structural distortion that relieves the geometrical frustration [9], compared to all other $LnBaCo_4O_7$ compounds. A single crystal study of the material reported a gigantic variation in electric polarization ~ 17 mC/m² at 10 K, and one of the highest reported linear magnetoelectric effect [10]. Further, this is a rare example of a magnetoelectric where Co is in tetrahedral coordination compared to most of the others that show octahedral or pyramidal coordination [10]. Since then, a lot of studies have been focused on this system aimed at tuning the transition temperatures, the magnetic ground state, magnetoelectric coupling, and polarization, by chemical substitution [11–15]. Later on, the material was argued to be a ferrimagnetic pyroelectric with non-switchable polarization [16]. The materials are nevertheless significant from the perspectives of applications and also fundamental aspects.

Although there are several investigations in the series related to structural, magnetic, and dielectric properties, the electrical conduction dynamics of the materials is still far from known. Complete knowledge of the properties of the materials, including the electrical sector, is required for any possible applications of the materials such as pyroelectric sensors or thermometers, solar energy pyroelectric converters, PIR sensors, or cooling using magnetocaloric or electrocaloric effects [17]. The materials are highly resistive in the low-temperature range and semiconducting in the high-temperature range. In this context, the study of conduction dynamics and dielectric properties using ac spectroscopy tools is quite significant. Besides, the intriguing interplay of charge and lattice degrees of freedom in the materials points out the need for an in-depth characterization of the conduction dynamics in the materials for fundamental knowledge. For example, CaBaCo₄O₇ exhibits charge ordering due to a mixed-valent state of Co cations [9]. Among the four nonequivalent Co sites, Co1 alone occupies the triangular layer while Co2, Co3, and Co4 occupy the kagomé layer. Although Co is expected to be nominally in an average 2.5+ oxidation state with two Co²⁺ cations (Co2 and Co3) and two Co³⁺ cations (Co1 and Co4), an earlier

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Polyethylene Glycol (PEG-200): An Efficient, Green and Biocompatible Reaction Medium for the Metal-Free Synthesis of Functionalized 1,4-Benzothiazines

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Polyethylene Glycol (PEG-200): An Efficient, Green and Biocompatible Reaction Medium for the Metal-Free Synthesis of Functionalized 1,4-Benzothiazines.

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An efficient, simple and biocompatible one-pot two-component PEG-200 catalysed approach for the synthesis of bioactive and medicinally important 1,4-benzothiazine derivatives from 2-aminobenzothiol and 1,3-dicarbonyl compound has been

demonstrated. Polyethylene glycol (PEG-200) has proved to be a new class of green and biocompatible reaction media for the metal free organic synthesis.

Introduction

Over the past decade, green chemistry has emerged as an important environmental aspect to reduce the use of toxic and hazardous chemicals in synthetic and industrial application. The use of eco-friendly catalysts and selected green solvents are of being promising demand in recent years for the synthesis of organic compounds.^[1] In terms of green chemistry, the development of efficient one-pot reactions has attracted much consideration regarding the use of biocompatible reaction media, heterogeneous catalyst^[2-11] etc. In this context explorative research in recent past has yielded Polyethylene glycol (PEG-200) as a new class of green and biocompatible reaction media for the metal free organic synthesis. Functionalized 1,4-benzothiazines, holding benzene amalgamated with a six-membered thiazine ring, acts for principal group of heterocyclic compounds, which display a wide variety of biological effects. For example, methyl-3-ethyl-6,8-dimethyl-4H-benzo[b][1,4]-thiazine-2-carboxylate has been used as antioxidant,^[12] antimicrobial,^[13] antifungal,^[14] 15-lipoxygenase inhibitor,^[15] neuroleptics,^[16] antirheumatic,^[17] anticancer,^[18] calcium antagonist,^[19] cardiovascular,^[20] antimalarial,^[21] anthelmintic^[22] agent. 1,4-benzothiazine derivatives have reported to possess wide applications in medicinal chemistry,^[23] for example it is used for the treatment of low blood sugar or as anti HIV agent^[24] etc. Apart from the above, the 1,4-benzothiazine is a fractional monetary unit of countless native pigments, dyestuffs and also available in one type of melanin, pheomelanin.^[11,12] Because of the enormous bioactivity of this heterocyclic framework, few synthetic plan of action has been reported.^[13-16] Even so, most of these plan of action suffers from diverse drawback such as the use of expensive catalyst, environmentally hazardous reagent, long reaction time and high reaction temperature. Keeping these in mind and as we know one-pot reactions are

energy saving processes that eliminates the multiple steps and increases the productivity with high level of structural diversity,^[10-24] we applied polyethylene glycol-200 (PEG-200), as a solvocatlyst for the one-pot synthesis of 1,4-benzothiazine derivatives from 2-aminobenzothiol and 1,3-dicarbonyl compounds.

Result and Discussion

We began our explorative work by taking a mixture of dimedone and 2-aminothiophenol as a model reaction. Firstly we tried the reaction in different green solvents like PEG-200, PEG-300, PEG-400, PEG-600, glycerol and water at different temperatures. For the optimization of reaction conditions, the parameters such as solvent, temperature, time were found to have influence on the reaction and it was monitored by TLC. The experimental observations are summarized in Table 1. Initially, the model reactions were carried out in water in reflux condition, but we did not get the expected product (Table 1, entry 3). When the reaction was performed in methanol and ethanol under reflux condition and in glycerol at 90 °C, we get the desired product but the yield of the product was low (Table 1, entry 1, 2, 4). We also carried out the model reaction in presence of various greener solvents like PEG-200, PEG-300, PEG-400 and PEG-600 under the identical reaction condition (Table 1, entry 5-8). Among these solvent PEG-200 showed high yield of the desired product at 120 °C (Table 1, entry 5). On decreasing the temperature to 80 °C, the yield remained almost the same. Further on increasing or decreasing the time it was observed that the yield remained almost the same as the previous one (Table 1, entry 12, 13). When the reaction was carried out at room temperature, we did not get the desired product even after 24 h (Table 1, entry 16). Further change in the reaction parameters could not increase the yield of the desired product. Hence, we conclude that the reaction at 80 °C in PEG-200 is the optimized reaction condition (Table 1, entry 11).

With this optimized condition, as in Table 1, entry 11, i.e., carrying out the reaction simply by mixing 2-aminothiophenol (1 mmol) and dimedone (1 mmol) with the PEG-200 (5 mL) and stirring for 4 h at 80 °C, we explored the generality of the

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Molecular iodine catalyzed C(sp²)-H sulfenylation of biologically active enaminone compounds under mechanochemical conditions and studies on their biocidal activity including molecular docking and DFT

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Molecular Diversity
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ORIGINAL ARTICLE



Molecular iodine catalyzed C(sp²)-H sulfenylation of biologically active enaminone compounds under mechanochemical conditions and studies on their biocidal activity including molecular docking and DFT

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Abstract

Here we demonstrated a solvent free, mechanochemical I₂ catalyzed C(sp²)-H sulfenylation of enaminones under grinding condition. Only catalytic amount of I₂ is required on silica surface without any external heating. The reaction time has reduced to a great extent in comparison to their solution based counterpart. The frictional energy created by ball-mill on mesoporous silica materials has attracted much attention towards this mechanochemical approach for molecular heterogeneous catalysis. Their large surface area and well defined porous architecture certainly increase the catalytic ability of iodine in this developed protocol. Anti-microbial activities of our synthesized compounds were investigated against two gram positive (*Staphylococcus aureus* and *Bacillus cereus*) and two gram negative (*Escherichia coli* and *Klebsiella pneumonia*) bacteria. To understand the potency of these compounds (3a–3m) as antimalarial agents, molecular docking studies were also performed. Density functional theory was also used to investigate the chemical reactivity and kinetic stability of the compound 3a–3m.

Keywords Anti-microbial activities · Antimalarial agents · Mechanochemical · Metal free · Solvent free

Introduction

The field mechanochemistry was first introduced in the late 1890s with the studies of M. Carey Lea on the effect of mechanical energy on silver halides [1–3]. In modern time, mechanochemical method have been employed in organic synthetic methodology to tackle the issue of environmental pollution [3–22]. The widespread application of organosulfur compounds, has created an immense interest for the construction C–S bonds [23, 24]. The most common strategy for the accumulation of C(sp²)-S bond involves transition metal catalyzed cross-coupling reaction between thiols and aryl/alkenyl halides [24]. Although this approach is apparently simple, it genuinely depends on the use of exorbitant catalysts, bases and noxious solvents thereby

compromising environmental safety. Moreover, the selection of various sulfur surrogates also has intense effect on the strategy employed. Among the various sulfenylation reagents (sulfenyl halides, sulfonates, sulfonyl hydrazides, etc.), disulfides remain the most commonly engaged thiolation reagent because of its ready obtainability, ease of pick up, bargain-counter and broad structural heterogeneity [25]. From the literature survey we got some reported method [26–30] metal catalyst C(sp²)-H bond sulfenylation using high temperature. The origination of C–S bonds via transition metal-free C(sp²)-H bond functionalization are fairly limited.

Considering environmental safety and biodiversity, reaction methodology that are transition metal-free, solvent-free and atom-economic have been making an appearance swiftly as a new trend. In the middle of all the known practices of credible organic synthesis, ball-milling is making an appearance as a green tool with extensive future. This mechanochemical process allows logical blend of reactants under solvent-free condition and is an auspicious way to accelerate organic reactions. One of the main snags of traditional solvent-free reaction is the necessitous yield due

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A Chromo-fluorogenic Probe for Selective Detection of Picric Acid Alongside Its Recovery by Aliphatic Amines and Construction of Molecular Logic Gates.

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RESEARCH



A Chromo-fluorogenic Probe for Selective Detection of Picric Acid Alongside Its Recovery by Aliphatic Amines and Construction of Molecular Logic Gates

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Abstract

Nitroaromatic compounds are illicit explosive chemicals. For environmental security and homeland safety, selective and sensitive identification of these secondary-class explosives has been a reason for the exhaustive research arena of chemists for about a decade. We introduced a sensitive optical sensor with desalted neutral red (NR) dye. After ingressing picric acid (PA) in acetonitrile, the probe becomes non-fluorescent, displaying a colorimetric change from yellow to pink. The quenched phenomena and the changed color were re-established with aliphatic amine, trimethylamine (TEA). The reversibility is produced cyclically, both in fluorimetrically and spectrophotometrically. The detection limit for PA with our probe comes out as 0.639 μM ; this value is significantly lower than many chemosensors available in the literature. Also, NR-stained filter paper strips-based test kit analysis has been deployed as a displayable photonic device for in-situ detection of PA. Furthermore, the whole system was conceptualized to produce single input, single output, and double input single output logic gates, which can be applied to digital devices. The chronological input manner as NTP (NR- TEA-PA) pushed us to configure a molecular keypad lock system, the basis of digital locking devices. The repeatable & reversible detection system exhibits "Write read- Erase-read Write-read" type memory devices.

Keywords Picric acid · Reversibility · Logic gates · Molecular keypad · Paper strip

Introduction

Nitroaromatic compounds contain at least one nitro group with other functional group/s in a compound. Due to the presence of nitro group/s, these are members of explosives. As the name suggests, working with explosives for practical purposes is challenging and hazardous. However, when one of the members of these explosives tends to mix into drinking water, it concerns the researchers. Picric acid (PA) or trinitrophenol (TNP) is a member of nitroaromatic compounds (NACs). PA is known to be the ancient method for determining reducing sugars by replacing the nitro groups with amines. Besides, it is widely used in clinical biochemical practice to determine creatinine in plasma or serum. In contraposition, it is one of the significant surface water

and soil as well as air pollutants that mixes into water after being released from industrial plants such as pharmaceutical industries, dye manufacturing units, glass manufacturing plants, leather industries, battery industries, and also from all types of fireworks units as it is an explosive chemical due to presence of nitro groups. Not only that, but it is also a central toxic element to marine life, humans, and animals, as it causes skin and eye irritation and is even carcinogenic. The NACs are of two types: (a) phenolic and (b) non-phenolic. Structurally, NACs are electron deficient π -system, and as the number of nitro groups increases, the electron deficiency also increases. The most commonly known explosive is trinitrotoluene (TNT), but PA has been superior in energy content ever since Hermann Sprengel proved in 1871 that it can be detonated. PA is odorless, yellow-colored crystals; wet PA is the yellow solution in water and organic solvents. But wet PA tends to lose moisture and becomes shock fric-

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A square planar copper(II) complex noncovalently conjugated with a *p*-cresol for bioinspired catecholase activity.

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A square planar copper(II) complex noncovalently conjugated with a *p*-cresol for bioinspired catecholase activity

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RESEARCH ARTICLE

ABSTRACT



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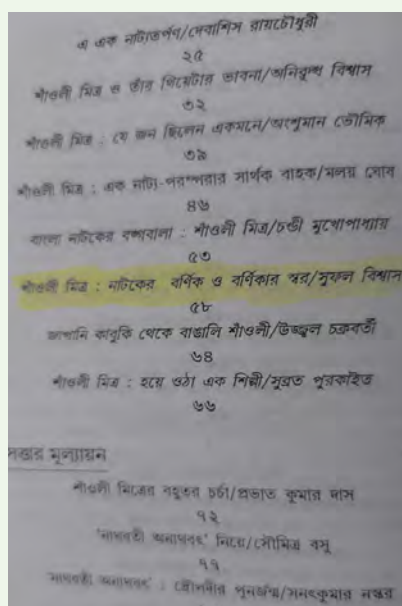
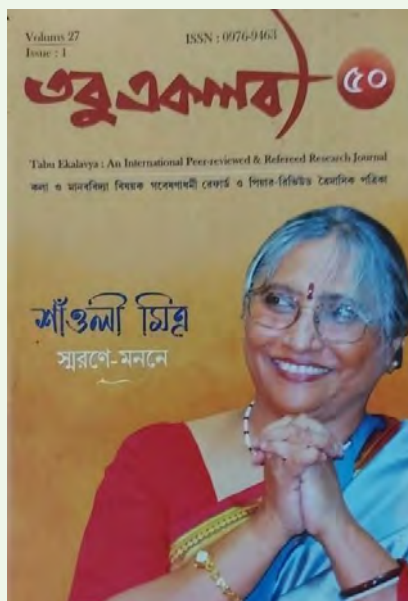
This work presents the synthesis of an unprecedented *p*-cresol-conjugated copper(II) complex as a *p*-cresol-coupled polydentate ligand, its crystal structure, and catecholase activity. X-ray crystallography reveals that the Cu(II) centre adopts a nearly planar coordination geometry. Crystal data for $C_{14}H_{12}CuO_5$: Monoclinic, space group $P2_1/c$ (no. 14), $a = 5.9204(2)$ Å, $b = 21.5615(10)$ Å, $c = 9.0715(4)$ Å, $\beta = 91.266(4)^\circ$, $V = 1157.72(8)$ Å³, $Z = 4$, $\mu(\text{MoK}\alpha) = 0.987$ mm⁻¹, $D_{\text{calc}} = 1.498$ g/cm³, 12647 reflections measured ($6.884^\circ \leq 2\theta \leq 63.42^\circ$), 3233 unique ($R_{\text{int}} = 0.0618$, $R_{\text{sigma}} = 0.0512$) which were used in all calculations. The final R_1 was 0.0710 ($I > 2\sigma(I)$) and wR_2 was 0.2173 (all data). The crystallized *p*-cresol was localized in complex units through intermolecular O...H interactions and formed a 3D supramolecular framework employing short-ranged O...H and C-H... π interactions in the solid state. The copper(II) complex has been evaluated as a bioinspired catalyst in the oxidative transformation of 3,5-di-*tert*-butylcatechol (DTBC) to *o*-benzoquinone in acetonitrile with a high turnover number, 2.26×10^4 h⁻¹. Electrochemical analysis of the copper(II) complex in the presence of DTBC recommends the generation of a catechol/o-

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বাংলা কবিতায় নদী: নদীর কবিতায় বাংলাদেশের শরীরী প্রত্যয়

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বিমূর্ত: বাংলার বিচিত্র ভূপ্রকৃতিতে নদী আসলে শুধুমাত্র নৈসর্গিক সৌন্দর্য নয়, সে আসলে জীবন ও অনুভূতিরই একটি অংশ। প্রধানত নদীকে কেন্দ্র করেই গড়ে উঠেছিলো মানুষের বসতি। শহর, নগর, বন্দর পৃথিবীর সকল সভ্যতার সূচনা নদীরই আদরমাখা কোলে। সভ্যতার উন্মুল্ল থেকেই নদীর কাছে মানব সভ্যতার ঋণ অপরিসীম। নীল নদের তীরে মিশরীয় সভ্যতা, সিন্ধু নদের তীরে মহেঞ্জোদারো-হরপ্পা সভ্যতা, ইউফ্রেটিস ও টাইগ্রিস নদীর তীরে মেসোপটেমিয়া ও ব্যাবিলনীয় সভ্যতা, ভূমধ্যসাগরের তীরে ইজিয়ান সভ্যতা গড়ে উঠেছে নদীকে মান্যতা দিয়েই। বাংলাদেশ নদীমাতৃক দেশ। মানব শরীরে সচল রক্তশিরার মতো নদীও এ দেশের প্রাণ। আমাদের শিল্প-সাহিত্য, সংস্কৃতি, রাজনীতি, সংগ্রামে নদীর সার্বিক উপস্থিতি নদীকে যেমন চরিত্র করে তুলেছে তেমনি নদী হয়ে উঠেছে সমস্ত আশা নিরাশা তাড়িত অনুভূতি প্রকাশের ধাত্রী মা। গত শতকের ষাটের দশকে হাজার বছরের শৃঙ্খল ভেঙে মুক্তিকামী তরুণরা যে স্লোগান দিয়েছে সেখানেও আছে নদীকেন্দ্রিক পরিচয়ের প্রাধান্য,

'পদ্মা-মেঘনা-যমুনা

তোমার আমার ঠিকানা।'

এ শুধু স্লোগান নয়, নদীকেন্দ্রিক জন্মভূমির প্রতি এক প্রবল জীবনাবেগ এক নিজস্ব সত্তা রক্ষার অঙ্গীকার। বাংলা কবিতায় কবির কলমের তুলিকায় কিভাবে আঁকা হয়েছে বাংলা নদী অনুভূতি তাকেই তুলে ধরার চেষ্টা হয়েছে আলোচ্য পত্রে।

চুম্বক শব্দঃ কবিতা, সভ্যতা, আধুনিক, মানুষ, নদী, জীবন, আত্মা, জল, মাটি

*"I am the river become night.
I go down by the broken depths,
by the forgotten unknown villages,
by the cities crammed to the very windows with people.
I am the river,
I flow through the prairies.
The trees on my banks are alive with doves.
The trees sing with the river,
the trees sing with my bird's heart,
the rivers sing with my arms."*

(The River : Javier Heraud Translate by Timothy Allen)

'গঙ্গা জউনা মাঝে রে বহই নাই

তঁহি বুড়িলী মাতঙ্গি পোইআ লীলে পার করেই।'

(১৪ নম্বর চর্যা : ডোয়ীপা)

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Urbanisation & Growth Of Slum Population In West Bengal : An Analysis With Spatial Technoqe.

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Urbanisation and Growth of Slum Population in West Bengal: An Analysis with Spatial Technique

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Abstract

Cities and towns expand as a result of urbanisation, which is a process brought on by industrialization and economic growth. The paper's goal is to investigate the situation regarding West Bengal's rapid urbanisation and population expansion in slum areas. India's urbanisation movement has resulted in slums blending into the metropolitan landscape. One of the key factors contributing to the expansion of slums in India is rural-urban migration. 1.21 billion people call India home, with 31.30 per cent of them living in cities. Of this urban population, however, 61.8 million people, or 21.68 per cent, resided in slums. To assess the data, the population of the city and the slums has been compiled per district using a variety of secondary sources. The article comes to the conclusion that all districts are seeing an increase in the rate of Urbanisation, which has resulted in an increase in the population of slums.

KEYWORDS: urbanisation, slum, growth of slum, west Bengal, population

INTRODUCTION

Urbanisation is a process that results in the expansion of cities and towns as a result of economic growth and industrialisation. It also causes changes in specialisation, labour division, and human behaviour that are unique to urban areas. Slums have several definitions around the world; however they vary from nation to nation and depend on the government. By 2050, it is anticipated that 64 per cent of Africa and Asia and 86 per cent of the developed world would have urbanised populations (The Economist, 2012). Notably, the UN has also recently predicted that cities will absorb almost all of the increase in global population between 2017 and 2030, adding about 1.1 billion new urban residents over that time (Barney 2015: 4-7). The process of Urbanisation is not primarily driven by migration but rather by the demographic explosion brought on by natural growth. Urbanisation and slums are complimentary to each other, with the rising rate of Urbanisation the rate of slum also increases. One report disclosed by Urban Land Policy of United Nation, defines a slum as, "building, group of buildings or area classified by over-crowding, insanitary conditions, deteriorations or absence of facilities or amenities which because of such conditions or any of them, posses risk for the health, safety or morals of its inhabitants or the community". Indian Government defines a slum as " any predominantly residential

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Transformation of Socio-economic life of population: A Case Study of Tomba Village, Matigara, West Bengal

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Transformation of Socio-economic life of Population: A Case Study of Tomba Village, Matigara, West Bengal

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Abstract

Socio-economic study of population at village level has significance importance in micro-regional planning. It enriches the knowledge about the various aspect of that area from literacy, age-sex structure to social status of the people. The selected study area is Tomba village, which is only 5 km away from the Siliguri town. In this paper, an attempt has been made to study the socio-economic life of the study area. The study is based on the primary field survey of 97 houses and the secondary data published by Census of India, 2001, 2011. The study shows that decadal population growth (2001-2011) of the village is 173 % and male literacy rate has declined by 5%, even the area has good connectivity with Siliguri. Female marginal workers rate is high in comparison with other occupational activities. Population influx from the surrounding states and district especially Bihar and Northern district of West Bengal like Cooch Behar, Jalpaiguri etc. is quite high in this area. To study the road network connectivity different types of indices have been used to show the accessibility.

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Some Aspects of Divorce in Hindu Law and Scriptures *Tamali Mustafi, Dept of History*

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Some Aspects of Divorce in Hindu Law and Scriptures

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ABSTRACT:

The process of ending a marriage is called divorce. It usually dissolves the bonds of matrimony between a married couple. There are several contradictions within Hindu Scriptures regarding divorce and its legalization as well as implementation. Similar to early Christianity, Hinduism believed that marriage was an unbreakable bond. However, *Dharmashastra* permitted divorce before the beginning of the Christian era. According to *Kautilya's Arthashastra*, judicial permission was inevitable before the second marriage, which indicates the practice of divorce must have prevailed in Ancient Indian Society. Recorded cases of divorce are not found in Brahmanical tradition, while Buddhist literature has references. The Hindu Marriage and Divorce Act of 1955 allows divorce on the basis of some grounds like a change of religion, cruelty, suffering from venereal disease, rendering staying with the other party unsafe etc. A modest effort has been made in this study to concentrate on the many elements of divorce under Hindu law and its benefits and drawbacks.

Keywords: Divorce, Hindu law, Scriptures

The process of ending a marriage or marital union is known as divorce or dissolution of marriage. The legal obligations and responsibilities of marriage are often canceled or rearranged as part of a divorce, which dissolves the bonds of matrimony between a married couple under the laws of the specific nation or state.¹

General Hindu law did not recognize divorce since it was believed that marriage was an unbreakable bond between a husband and woman, much like early Christianity. Divorce is legal under Hindu civil law under specific conditions. But since divorce is not a part of Hinduism as a whole, the religion as a whole does not support it. Hindu scriptures claim that marriage is a sacrament, a heavenly bond, and a holy union. Marriage is not a place for sexual gratification; it's a place for procreation and the continuance of family lines. It must be done; it is a duty. A principle of Hinduism that, if accepted, both partners must uphold for the rest of their lives. Therefore, marriage is a holy bond that cannot be broken by divorce for selfish or personal reasons.

Women had little independence in Hindu culture in the past. Women were kidnapped, sold, forced into marriage, forced into prostitution, and kidnapped and sold. In Hindu civilization, there was no such thing as a divorce or a formal separation. When a woman left her parent's house, she was entirely at the mercy of her partner or his parents. If he thought she was unsightly or unsuitable and left her, there wasn't much she could do. She lacked the legal authority to get a divorce, get remarried, go outside or speak to anybody without her husband's consent.²

The situation was different for males. Men possessed various rights and advantages that came with their role as defenders of dharma, which they exercised for reasons of convenience, expediency, or even their own personal beliefs. An instance in point was Sita's anguish in the epic *Ramayana* when her husband left her for the sake of righteousness. Lord Ram, a shining example of integrity, devotion, and morality, deserted his wife, whom he loved, at the slightest suspicion that she could have been unfaithful. Despite the fact that he lacked evidence, he moved quickly to protect dharma and exiled her into the jungle despite the fact that she was innocent and pregnant. As the monarch and defender of dharma, Rama was thus obligated and had no alternative but to do his duty unless he wanted to seem hypocritical.³

Manu said that a woman might not be freed by her husband either by sale or by abandonment, meaning that the marital relationship cannot be dissolved in any manner. However, if we carefully review the older *Dharmashastra* literature, we discover that divorces were legal prior to the advent of Christianity in certain cases. It's noteworthy to note that even Manu himself says in another chapter of his book that a woman is not at fault if she leaves a husband who is sterile, demented, or afflicted with an infectious or incurable disease. This husband's departure amounted to a virtual divorce since Manu allows such a woman to remarry if her first marriage was not legally completed.⁴ Here lies the self-contradiction in Manu's statement.

In accordance with *Kautilya's Arthashastra*, an unrecognized type of marriage may be ended by mutual agreement. Manu, however, rejects the idea of ending a marriage. In a nutshell, this might be seen as the ultimate dharma of the husband and wife. He says, "Let mutual fidelity continue till death."⁵ **Kautilya** provides comprehensive divorce guidelines for couples who are unable to coexist as a pair. However, they were only applicable to marriages between Asuras, Gandharvas, Kshatriyas, and Paisachas. Even though these marriages were more frequent among the lowest layers of society, they were also prevalent among Brahmanas and Kshatriyas; consequently, divorce must have been somewhat common among the upper castes as well.⁶

A lady remarries in the Atharvaveda at one point, most likely within the previous husband's lifespan. Of course, her second marriage implied a divorce. Writers of the *Dharmasutra* (400 BC to 100 AD) stipulate that a Brahmana lady must wait for her husband to return after a long voyage for five years;

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