MAHISHADAL RAJ COLLEGE

SESSION: 2018-2019

Total number of PUBLICATIONS in Journals: 14
(SCI/SCIE/SCOPUS/UGC-indexed: 9)

Faculty of Science

Journals (SCI/SCIE/SCOPUS/UGC-indexed)

1. Aditi Khanra, Tandra Pal, **Manas Kumar Maiti**, and Manoranjan Maiti. "Multi-objective four dimensional imprecise TSP solved with a hybrid multi-objective ant colony optimization-genetic algorithm with diversity." *Journal of Intelligent & Fuzzy Systems* 36, no. 1 (2019): 47-65, DOI: 10.3233/JIFS-172127, ISSN online: 1875-8967.
2. Indadul Khan and **Manas Kumar Maiti**. "A swap sequence based artificial bee colony algorithm for traveling salesman problem." *Swarm and evolutionary computation* 44 (2019): 428-438, https://doi.org/10.1016/j.swevo.2018.05.006, Print ISSN: 2210-6502, Online ISSN: 2210-6510.
3. Prasenjit Pramanik and **Manas Kumar Maiti**. "An inventory model with variable demand incorporating unfaithfulness of customers under two-level trade credit." *European Journal of Industrial Engineering* 13, no. 4 (2019): 461-488, https://doi.org/10.1504/EJIE.2019.100957, ISSN online: 1751-5262, ISSN print: 1751-5254.
4. Rabin Kumar Mallick, Shyamal Kumar Mondal, and **Jayanta Kumar Dey**. "ANALYSIS OF LEAD TIME ON PERMISSIBLE DELAY IN PAYMENTS IN AN INVENTORY MODEL INCLUDING THE LEAD TIME CRASHING COST." *Advanced Mathematical Models & Applications* 3, no. 2 (2018), http://jomardpublishing.com/UploadFiles/Files/journals/AMMAV1N1/V3N2/MallickRK.pdf, ISSN: 2519-4445 (Online).
5. **Nababrata Ghoshal**, Soumyajit Pramanick, Sudeshna DasGupta, and Soumen Kumar Roy. "Monte Carlo study with reweighting of uniaxial nematic liquid crystals composed of biaxial molecules." Physical Review E 99, no. 2 (2019): 022703, https://doi.org/10.1103/physreve.99.022703, Print ISSN: 2470-0045, Online ISSN: 2470-0053.
6. Sudeshna DasGupta, Sabana Shabnam, Soumyajit Pramanick, **Nababrata Ghoshal**, Ananda DasGupta, and Soumen Kumar Roy. "Pressure-induced phase transitions in liquid crystals: A molecular field approach." Physical Review E 98, no. 2 (2018): 022701, https://link.aps.org/doi/10.1103/PhysRevE.98.022701, Print ISSN: 2470-0045, Online ISSN: 2470-0053.
7. Bhriguram Das, Atanu Jana, Ananya Das Mahapatra, Debprasad Chattopadhyay, Anamika Dhara, **Subhabrata Mabhai**, and Satyajit Dey. "Fluorescein derived Schiff base as fluorimetric zinc (II) sensor via 'turn on'response and its application in live cell imaging." *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 212 (2019): 222-231, DOI: 10.1016/j.saa.2018.12.053, Print ISSN: 1386-1425, Online ISSN: 1873-3557.
8. **Joydeb Manna**, Nagaraju Shilpa, Arun Kumar Bandarapu, and Rohit Kumar Rana. "Oxyanion-binding in a bioinspired nanoparticle-assembled hybrid microsphere structure: effective removal of arsenate/chromate from water." *ACS Applied Nano Materials* 2, no. 3 (2019): 1525-1532, https://doi.org/10.1021/acsanm.9b00003, Web Edition ISSN: 2574-0970.

Journal (Others)

9. **Subikash Mookherjee**, Sanjoy Kumar Pattanayek, and Debasish Mondal. "Assessment of Urbanization in Census-units through Construction of a Generalized Urbanization Index: A Study for Economically Backward Regions of West Bengal During 1991 to 2011." Vidyasagar University Journal of Commerce 24, (2019): 1-27, ISSN: 0973-5917.
10. **Joydeb Manna**. "Surface enhanced Raman scattering: Mechanism and suitable Nanomaterials for detection of trace molecules." International Journal of Physiology, Nutrition and Physical Education 4, no. 1 (2019): 2558-2562, https://www.journalofsports.com/pdf/2019/vol4issue1/PartAV/6-2-92-177.pdf, ISSN: 2456-0057.

Faculty of Humanities & Social Science

Journals (UGC/Peer-reviewed)

11. **Asis De** and N. Maiti. 'Exploitation of the Nature and the Transformation of the Wild in Stephen Alter's In The Jungles Of The Night' in New Academia: An International Journal of English Language, Literature and Literary Theory (UGC Journal No. 44829), Vol. VIII, Issue II, April 2019, pp. 308-318. (Online ISSN 2347-2073).
12. **Asis De** and M. Misra. 'The Mystique Mountain: Nanda Devi in the Eyes of Bill Aitkin, Hugh Thomson and Stephen Alter' in **Literary Studies** (Journal published by Literary Association of Nepal) Vol. 32, Kathmandu, March 2019, pp. 1-11, (ISSN: 2091-1637).
13. **Asis De** "Transnational Kinship and Diasporic "Relatedness" in David Dabydeen's The Intended" in Litscape, Peer-Reviewed Journal of VUETC (Vidyasagar University English Teachers' Consortium), Vol.11, No.1, November 2018, pp. 34-43, (ISSN: 0976-9064).
14. **Asis De** "The Aesthetics of Becoming a Being in Manoranjan Byapari's Bangla Dalit Autobiography Itibritte Chandal Jivan", in Ravenshaw Journal of Literary and Cultural Studies, Ravenshaw University, Cuttack, 2018, pp. 113-126.

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Multi-objective four dimensional imprecise TSP solved with a hybrid multi-objective ant colony optimization-genetic algorithm with diversity

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Abstract. In real world, most of the combinatorial optimization problems are multi-objective and it is difficult to optimize them simultaneously. In the literature, some individual algorithms (ACO, GA, etc.) are available to solve such discrete multi-objective optimization problems (MOOPs), particularly travelling salesman problems (TSPs) . Here a hybrid algorithm combining ACO and GA with diversity is developed to solve discrete multi-objective TSPs and named MOACOGAD. Generally in TSP, routes for travel are not considered as lengths of routes remain unaltered. In real life, there may be several routes for travel from one destination to another and conditions of those routes may also be different such as good, rough, bad, etc. In practical, travel costs and travel times are not defined precisely and represented by fuzzy data. When fuzzy travel costs and fuzzy travel times per unit length are involved, the lengths and conditions of the routes along-with the types of conveyances for travel become important. In some cases, risk of travel is also involved. In this paper a four dimensional imprecise TSP including source, destination, conveyances and routes under some risk factors are formulated and solved by the developed MOACOGAD. The model is illustrated numerically. As particular cases three and two dimensional multi-objective imprecise TSPs are derived and solved.

Keywords: Ant colony optimization, Genetic Algorithm, fuzzy travel cost, fuzzy travel time, hybrid algorithm

1. Introduction

Travelling Salesman Problem (TSP) [3] is a NP-hard and also one of the most complex combinatorial optimization problem which cannot be solved exactly in polynomial time. Some investigations with respect to 2-dimensional TSP and 3-dimensional TSP or solid TSP are available in literature. The goal of TSPs is to find a shortest path, exactly once passing through each city in a given set of cities. When there is only one route and one conveyance for travel between any two cities are known as 2-dimensional TSP [17, 24]. 3-dimensional TSP [10] could be termed when several conveyances at each node/city are available.

Single objective classical TSPs [5, 14] can be solved by Ant Colony Optimization (ACO) algorithm which was introduced by Dorigo and Gambardella [16], inspired by the behaviour of ants in finding paths from nest to food. In 2012, Gaifang Dong et al.[14] proposed a cooperative genetic ant system for solving TSP. In 2013, Bai et al. [5] proposed a model for Asymmetric TSP which includes max-min ant colony optimization.

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A swap sequence based Artificial Bee Colony algorithm for Traveling Salesman Problem

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ABSTRACT

In this research paper, Artificial Bee Colony algorithm is modified with multiple update rules and K-opt operation to solve the Traveling Salesman Problem. Here the features of swap sequences and swap operations on the sequence of cities (solution/path) of the problem are used to create different solution (path) update rules of the algorithm. Eight different rules are proposed to update solutions in the algorithm. Updation of a solution by an employed bee or by an onlooker bee is done by a randomly selected rule from the rule set using Roulette Wheel selection process. In the scout bee phase of the algorithm, the perturbation technique, K-opt operation is applied on any stagnant solution for a fixed number of times for the possible improvement of it. The K-opt operation is again used at the end of the search process to improve the quality of the final solution (if possible). Proposed method is tested with a set of benchmark test problems from TSPLIB and it is observed that the efficiency of the algorithm is adequate with respect to the accuracy and the consistency for solving standard TSPs (Symmetric as well as Asymmetric) compared to the existing algorithms in the literature.

1. Introduction

The Traveling Salesmen Problem (TSP) is one of the standard combinatorial discrete optimization problem. The problem consists of a set of N vertices (nodes/cities) where the distance between any two vertices is known. A salesman starts from a vertex, visits all the vertices exactly once and returned to the starting vertex in such a way that the total distance travelled is a minimum. So the goal of the problem is to find a shortest possible tour through the set of vertices such that each vertex is visited exactly once except for the starting vertex. It is a well known NP-hard problem, can't be solved exactly using any polynomial time algorithm [1,2]. In a TSP, when the distance between any two vertices x_i and x_j is equal to the distance between x_j and x_i then the problem is called Symmetric TSP (STSP) [3,4]. On the other hand, if the distance between the vertices x_i and x_j is not equal to the distance between x_j and x_i, for at least one pair of vertices then the problem belongs to Asymmetric TSP (ATSP) [5]. Generally, there are two approaches to solve a TSP: exact methods and heuristic methods. The exact methods require enormous time for larger N, thus the heuristic methods are typically used to solve a TSP. The exact methods include cutting plane [6], LP relaxation [7], branch and bound [8], branch and cut [9], etc. Only small size TSPs can be solved by exact methods in a reasonable time window. On the other hand, several TSPs have been solved using heuristics or soft computing based techniques such as Ant Colony Optimization (ACO) [3], local search [10], hybrid algorithm [11], Genetic Algorithm (GA) [12], Particle Swarm Optimization (PSO) [4], Artificial Bee Colony (ABC) [13], etc. There are several well established heuristics for STSP. Wang et al. [4] used concepts of swap operator and swap sequence, and redefined some operators of PSO on the basis of them to solve TSP. Combing the features of PSO, ACO and 3-opt a hybrid algorithm PSO-ACO-3-opt is presented by Mahi et al. [14] to solve standard TSPs. Akhand et al. [15] proposed PSO with partial search algorithm for solving TSPs. Akhand et al. [16] improved this algorithm to find solution of the TSPs and named it velocity tentative PSO. Geng et al. [17] proposed an effective local search algorithm based on Simulated Annealing (SA) and greedy search techniques to solve the TSPs. Jolai and Ghanbari [18] presented an improved Artificial Neural Network (ANN) approach for solving the TSPs. Dorigo et al. [3] proposed an Ant System to solve the TSPs. Dorigo and Gambardella [19] described an ACO capable of solving the TSPs. Bontoux and Feillet [20] proposed a hybrid algorithm to solve the TSPs. Beam-ACO algorithm, which is a hybrid method combining ACO with beam search was used to solve

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An inventory model with variable demand incorporating unfaithfulness of customers under two-level trade credit

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Abstract: In this research work, an inventory model has been developed under two-level trade credit policy with unfaithful customers. A percentage of the total customers are treated as unfaithful customers. Demand is influenced by customers' credit period, credit amount and selling price. Due to the vagueness of some parameters, the proposed model is formulated in both the crisp and fuzzy environments. The main purpose of this research work is to determine the optimal replenishment policy so that the total profit of the retailer is maximised. The existence of a solution to the problem is discussed theoretically and then some numerical experiments are undertaken. To find the marketing decision of a generalised model (when the number of variables increases) and for the fuzzy objectives, a soft computing technique is used. Some sensitivity analyses are performed to provide some managerial insights. Finally a conclusion is drawn and some future research directions are proposed. [Received: 14 November 2017; Accepted: 2 January 2019]

Keywords: inventory; trade credit; unfaithful customers; particle swarm optimisation; variable demand.

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ANALYSIS OF LEAD TIME ON PERMISSIBLE DELAY IN PAYMENTS IN AN INVENTORY MODEL INCLUDING THE LEAD TIME CRASHING COST

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Abstract. In this article, the lead time on permissible delay in payments in an inventory model including lead time crashing cost is discussed where lead time and business period are the decision variables. Also, the lead time dependent credit period has been considered which has two parts one being fixed and other being dependent upon lead time. Here supplier offers the credit period to the retailer only when supplier supplies the order before the end of the business period. Here model has been considered in the parlance of infinite time horizon in such a way that the system gets the maximum profit. There are two main cases of inventory models to be studied here. Finally, three different illustrative examples have been added to determine the optimal policy of the model and the sensitivity analysis of some parameters has been added in this model.

Keywords: credit period, crashing cost, lead time, inventory model.
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1 Introduction

Lead time is the time that elapses between the placement of an order and the receipt of the order into inventory. Lead time may influence customer service and impact inventory costs. From the literature, it is known that productivity of the company and its competitive position in the market depends on lead time. Traditionally, in an inventory models, minimization of total cost or, maximization of total profit has been considered as an objective function from either the supplier's or manufacturer's/retailer's side. In 1975, Das (1975) stated the effect of lead time on inventory and give a static analysis about it. Foote et al. (1988) presented a heuristic policies for inventory ordering problems with long and randomly varying lead times. Ouyang and Wu (1998) established a minimax distribution free procedure for mixed inventory model with variable lead time. Ben-Daya and Raouf (1994) presented an inventory models involving lead time as a decision variable. Glock (2012) discussed the inventory model in which customer service and responsiveness to production schedule changes can be improved by reduced lead time and reduction in safety stocks can be achieved. Hsiao (2008), He et al. (2005), Lan et al. (1999), Yang et al. (2005), Pan et al. (2004) stated that fixed lead time is not always appropriate for all inventory model in business, so they considered lead time as a decision variable. These authors have presented models which can be used to determine the length of lead time that minimizes the expected total relevant cost. Chopra et al. (2004) observed the effects of lead time uncertainty on safety stocks. Ouyang et al. (2004), Chang et al. (2006), and Wu (2004)

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Monte Carlo study with reweighting of uniaxial nematic liquid crystals composed of biaxial molecules

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We present a high accuracy Monte Carlo simulation study of the uniaxial nematic (N_U) to isotropic (I) phase transition of a lattice dispersion model of uniaxial nematics composed of biaxial molecules. The N_U-I coexistence curve terminating at the Landau critical point has been determined using the multiple histogram reweighting technique. A close investigation reveals a sharp departure in the nature of the N_U-I coexistence curve in the temperature-biaxiality parameter phase diagram in comparison to the earlier theoretical (either mean-field or computer simulation) predictions. The coexistence curve shows a change in curvature with increasing value of the degree of molecular biaxiality.

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I. INTRODUCTION

In recent years, a great deal of attention has been devoted to investigations of the phase transformations in thermotropic liquid crystals composed of bent-core molecules [1,2]. Such molecules can be assumed to possess D_{2h} symmetry and are commonly referred to as biaxial molecules, in contrast to the conventional uniaxial molecules having $D_{\infty h}$ symmetry. It is well known from Landau–de Gennes (LDG) [3] and Maier-Saupe mean field (MF) theories that the isotropic to nematic phase transition in thermotropic liquid crystals (LCs) composed of cylindrically symmetric molecules is weakly first order. This has been confirmed by experiments [4,5] as well as by computer simulations [6,7]. In a more recent experimental study, Wiant *et al.* [8] observed that the isotropic (I) to the uniaxial nematic (N_U) transition for LCs composed of biaxial (bent-core) molecules is notably weaker than conventional thermotropic LCs formed from uniaxial molecules. These authors observed [8] that for nematics composed of bent-core molecules $T_{NI} - T^- \approx 0.4\,^\circ$C, whereas for typical calamitic (rod-shaped) liquid crystals $T_{NI} - T^- \geqslant 1\,^\circ$C. Here T_{NI} is the nematic-isotropic transition temperature and T^- is the supercooling limit of the nematic phase.

Bent-core molecules possess a high degree of molecular biaxiality. The possible effects of molecular biaxiality on nematic order have been studied theoretically using a number of techniques. These include molecular field treatments [9–16], computer simulation studies of lattice dispersion models [17–20] and the off-lattice biaxial Gay-Berne model [21,22]. All these studies predict sequences of phase transitions, from N_U to I at a higher temperature and from biaxial nematic (N_B) to uniaxial nematic (N_U) at a lower temperature. Also a direct N_B to I transition is predicted at a particular molecular geometry.

Apart from the above observations, molecular field studies [14,16] have shown that the increase in degree of molecular biaxiality influences the N_U-I transition in a number of ways. First, as the molecular biaxiality parameter λ (a measure of the molecular biaxiality and to be defined later) increases, the nematic order parameter S at the phase transition becomes smaller and thus the jump in S at the N_U-I transition decreases. Second, the transition temperature T_{NI} decreases monotonically with increase in λ. Third, the difference between the N_U-I transition temperature and the orientational spinodal temperature (T^-) decreases monotonically with increasing λ and finally these two temperatures merge as λ approaches its critical value $\lambda = \lambda_C = 1/\sqrt{6} = 0.40825$.

More recently, a Monte Carlo (MC) simulation study [23] based on a lattice dispersion model investigated the influences of molecular biaxiality on the N_U-I transition using the multiple histogram reweighting technique [24], and the relevant part of the free energy was generated for two different systems: one composed of uniaxial molecules and the other of biaxial molecules. Although the work reported in Ref. [23] emphasized the effect of an external field on uniaxial and biaxial molecules, from free energy analysis it was pointed out that molecular biaxiality weakens further the weak first-order N_U-I transition. The investigations presented in Ref. [23] were limited to only two values of molecular biaxiality parameter (0 and 0.20) and also the aim of the study was different, namely the effects of an external magnetic field on nematic order.

The fact that the increase in λ leads to weakening of N_U-I transition was also observed in a previous MC study [18] from the plots of order parameter and heat capacity, where the same dispersion model with three different values of λ (0.2, 0.3, and 0.40825) was used. However, to explore the effects of molecular biaxiality on the N_U-I transition and the associated pretransitional behavior, more accurate simulation technique is necessary.

In this paper we present an MC study using the reweighting technique [24] on a lattice dispersion model to investigate

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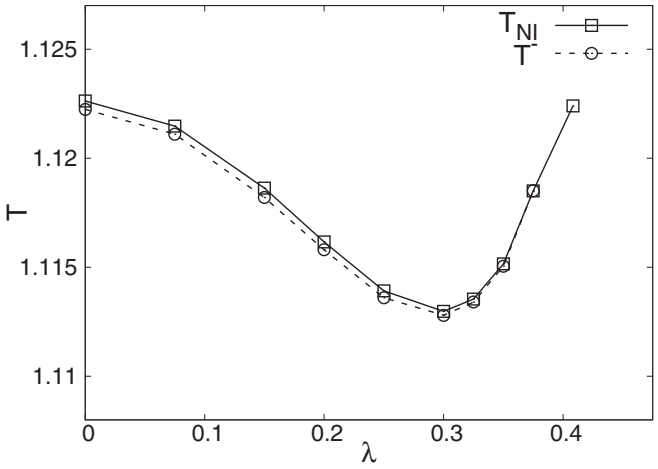

FIG. 4. T_{NI} vs λ phase diagram for the nematic-isotropic transition. The coexistence curve slopes downwards till $\lambda = 0.3$ and then slopes upwards till $\lambda = 1/\sqrt{6}$. The dashed curve represents orientational spinodal line. The error bars are smaller than the point size.

ordinate on the right corresponds to the free energy vs energy curve at T^-. Figures are plotted for λ values 0, 0.25, 0.3, and 0.325. We can see from the curves corresponding to T_{NI} that, as the value of biaxiality parameter increases, the depth of the free energy well decreases, taking the transition closer to being second order. For λ greater than 0.325 the depth of the free energy well at transition becomes so small that the structure of the well becomes nondiscernible from random fluctuations.

Investigators have also used the Lee and Kosterlitz finite size scaling method [34] to obtain the N_U-I temperature for $\lambda = 0$. Priezjev and Pelcovits [36] studied system sizes up to 70^3 using the single histogram reweighting technique [24] and obtained $T_{NI} = 1.1225 \pm 0.0001$ in the thermodynamic limit. This result is very close to what we obtained in the present study, namely $T_{NI} = 1.1226 \pm 0.0001$ for a system size 64^3. More recently Shekhar *et al.* [37] reported $T_{NI} = 1.1229 \pm 0.00015$ in a study similar to that of Priezjev and Pelcovits [36], but with relatively smaller system sizes (upto 40^3). Perhaps the use of smaller system sizes resulted in a slightly different value of T_{NI} obtained in this work. It may also be noted that, besides the transition temperature, our estimate of the depth in the free energy well (for $\lambda = 0$) is in close agreement with the finding of Priezjev and Pelcovits [36], namely of the order of 1.0ϵ.

Finally, in Fig. 4, we present the coexistence line and the orientational spinodal line in the λ-T plane. We see that both T_{NI} and T^- first decrease with increasing value of the biaxiality parameter and then increase with increasing λ. This observation deviates from the prediction of MF theory, which shows a monotonic nature of the T_{NI} vs λ curve, i.e., no change of curvature. While earlier MC simulations show no perceivable effect of molecular biaxiality upon T_{NI}. It should be noted that the exact nature of T_{NI} vs λ curve is revealed when T_{NI} is computed with sufficiently high temperature resolution Table I.

TABLE I. N-I transition temperatures for different values of the biaxiality parameter λ for the biaxial systems. Estimates of orientational spinodal temperature T^- are also listed for the systems having lower λ. The estimated (jackknife) error in each temperature is within ± 0.0001.

λ	T_{NI} [from χ vs T]	T_{NI} [from $F(E)$ vs T]	T^-
0	1.1227	1.1226	1.1222
0.075	1.1215	1.1214	1.1211
0.150	1.1187	1.1186	1.1182
0.200	1.1163	1.1162	1.1158
0.250	1.1140	1.1139	1.1136
0.300	1.1130	1.1130	1.1128
0.325	1.1136	1.1135	1.1134
0.350	1.1151	1.1151	1.1150
0.375	1.1185	1.1186	1.1185
0.408	1.1224		

Another important observation is that the gap between these curves decreases monotonically and finally vanishes as λ approaches λ_C. A similar qualitative feature was found in the molecular-field theory study of To *et al.* [16].

V. CONCLUSION

We have reported the results of a MC study of a uniaxial nematic system composed of biaxial molecules. The temperature resolution used in this work is more than what is available in previous MC studies. The peculiar nature manifested in the change of curvature of the T_{NI}-λ curve exhibited in Fig. 4, to our knowledge not obtained in any previous MC work or MF studies, is the main finding of our work and needs to be explained by rigorous theoretical methods.

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Pressure-induced phase transitions in liquid crystals: A molecular field approach

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A rigorous microscopic treatment of a nematic fluid system based on a pairwise interaction potential is immensely complex. For studying such systems molecular field theories are often the standard method of choice. In this paper we have chosen a simple effective potential $U = \frac{u_4}{v^4} - \frac{u_2}{v^2} - \frac{Au_2}{v^2}\langle P_2\rangle P_2(\cos\vartheta)$ to study an isothermal-isobaric ensemble describing a liquid crystalline system. Using this we have studied in particular the pressure dependence of liquid crystalline phase transitions.

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I. INTRODUCTION

Studies of phase transitions in liquid crystalline materials are of extreme importance because of their various important applications. For more than a century different experiments and corresponding theoretical studies have established the existence and behavior of different liquid crystalline phases. These studies involve the measurement of variation of different liquid crystalline properties such as orientational order parameter, dielectric constant, specific heat, isothermal compressibility, isobaric expansivity, etc. with the temperature [1–3]. Most of these thermodynamic measurements have been done on nematics at constant pressure, so that as temperature is varied, the molar volume also varies as a result of thermal expansion. The temperature dependence of orientational order in a nematic liquid crystal at constant molar volume was difficult to measure. This was first carried out by McColl and Shih [4]. They published their results of the temperature and volume variation of the orientational order parameter in para-azoxyanisole (PAA).

One of the first experiments investigating the effect of pressure on mesophase transitions were conducted by Hulett in 1899 [5] just about a decade after the discovery of liquid crystals. Most of the work involving pressure dependence had been done during 1970s [4,6–9]. Then in 1975, Shashidhar and Chandrashekhar [6] in their experimental work presented the pressure variation of liquid crystalline materials in detail and generated the phase diagrams, which clearly showed the liquid crystalline phases and the appearance of tricritical points. Horn [2,3], on the other hand, determined the dependence of orientational order parameter with temperature by measuring refractive index. Later Horn along with Faber explained these experimental data using a mean-field approach [7]. Wallis and Roy [8] again by the proton NMR spectrum study, studied the line width of proton resonance as function of temperature and pressure for the nematogens 5, 6, 7, and 8 CB and also for some other nematogens including PAA. They showed that the value of the orientational order parameter at the nematic-isotropic transition decreases with increasing pressure for 5, 7, and 8 CB but remained constant for 6 CB. The pressure and temperature dependence of the orientational order parameter for different sites in a mesogen were reported by Emsley *et al.* [9]. They showed that the quadrupolar splitting at the nematic isotropic transition temperatures is independent of pressure for different sites of the alkyl chain. In 1980, Luckhurst and Romano [10] considered an anisotropic part of the intermolecular potential along with the isotropic part and carried out computer simulation studies to find the phase diagram for some liquid crystals, but they had not considered any variation in pressure. In 1999, Hess and Su [11] used a generalization of the Lennard-Jones potential to study both the pressure and temperature variation of their liquid crystal model with density and observed a pseudotricritical point.

The stability of the nematic liquid crystal phase arises from the existence of strong interactions between pairs of the constituent molecules. This interaction between molecules leads to a long-range orientational order in the nematic phase. In most realistic situations, a rigorous microscopic treatment of a nematic fluid system based on a pairwise interaction potential becomes immensely complex. For systems of comparable complexity, mean-field theories are often the standard method of choice. The celebrated Maier-Saupe molecular field theory [12] (also referred to as mean-field theory; for a clarification of the terminology being used here see Ref. [13]) of nematic liquid crystals correctly predicts the existence of a first-order phase transition between the nematic and isotropic liquid states. However, there has been no significant molecular field study of the pressure dependence of liquid crystalline phase transitions to date. In the present paper we have presented a

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so that

$$e^{Nf(v)} = e^{Nf(v_*)} e^{\delta^2 f''(v_*)/2} \left(1 + \frac{f'''(v_*)}{6\sqrt{N}}\delta^3 + \cdots\right)$$

and hence

$$\int e^{Nf(v)} dv = e^{Nf(v_*)} \int e^{\delta^2 f''(v_*)/2} \left(1 + \frac{f'''(v_*)}{6\sqrt{N}}\delta^3 + \cdots\right) \frac{d\delta}{\sqrt{N}}.$$

It is easy to see that this yields

$$\ln\left(\int e^{Nf(v)} dv\right) \approx Nf(v_*) + \ln\left(\sqrt{\frac{2\pi}{N|f'''(v_*)|}}\right) + \cdots.$$

Note that for very large values of N, the subleading term in the above expression, which is of order $\ln N$ is completely dominated by the leading term of order N so that we can use

$$\ln\left(\int e^{Nf(v)} dv\right) \approx Nf(v_*).$$

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Fluorescein derived Schiff base as fluorimetric zinc (II) sensor via 'turn on' response and its application in live cell imaging

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Cell imaging

ABSTRACT

A novel Schiff base **L** composed of fluorescein hydrazine and a phenol functionalized moiety has been designed and prepared via cost-effective condensation reaction. The L is utilized for selective sensing of Zn^{2+} over other environmental and biological relevant metal ions in aqueous alcoholic solution under physiological pH range. The binding of Zn^{2+} to the receptor **L** is found to causes ~23 fold fluorescence enhancement of L. The 1:1 binding mode of the metal complex is established by combined UV–Vis, fluorescence, and HRMS (high-resolution mass spectroscopy) spectroscopic methods. The binding constant (K_a) for complexation and the limit of detection (LOD) of Zn^{2+} is calculated to be $2.86 \times 10^4\ M^{-1}$ and 1.59 μM, respectively. Further photophysical investigations including steady-state, time-resolved fluorescence analysis and spectral investigations including NMR (nuclear magnetic resonance), IR (infrared spectroscopy) suggest introduction of CHEF (chelation enhance fluorescence) with the suppression of C═N isomerization and PET (photo-induced electron transfer) mechanism for the strong fluorescent response towards Zn^{2+}. Finally, the sensor **L** is successfully employed to monitor a real-time detection of Zn^{2+} by means of TLC (thin layer chromatography) based paper strip. The **L** is used in the cell imaging study using African green monkey kidney cells (Vero cells) for the determination of exogenous Zn^{2+} by Immunofluorescence Assay (IFA) process.

1. Introduction

Zn (II) ion, the second most abundant transition metal in the human body plays a crucial role in many biological processes. This includes normal human growth and development, an additional signaling role in the central nervous system which contains high levels of zinc, gene transcription, brain function, and mammalian reproduction, co-factor in hundreds of enzymes [1,2]. Recent studies have identified labile zinc as being critically involved in human pathophysiology and neurology [3,4]. For instance, a failure in Zinc homeostasis is linked to development of prostate cancer and Alzheimer's disease. Deficiency of micronutrient zinc leads to impaired cognition, immune dysfunction, diarrhea, and death, particularly in children under the age of 5 years [5]. The human genome encodes two dozen Zn^{2+} specific transporters and many metal-buffering proteins, which are expressed in a tissue-specific manner [6]. Although Zn^{2+} is essential for cell function, accumulation of Zn^{2+} to toxic levels leads to cell death [7–9]. These factors thus trigger us for the detection and development of a new class of Zn (II) sensors. Schiff bases play a crucial role in host-guest chemistry as chemosensors being that the nitrogen atoms present exhibits a strong tendency to bind metal ions and implies its applications in recognition. Fluorescence sensors are powerful tools in the detection of ions/small molecules, because of their high sensitivity, excellent selectivity, and quick response speed. Such type of sensors normally contains two parts viz., a receptor that specially interacts with the target and a fluorophore that translates the molecular recognition to fluorescence signal. Fluorescent sensors based on Schiff base attract special attention owing to their easy synthesis, variable structures, and cheap raw materials. In recent years, the fluorescein and its derivatives were used as excellent fluorescence chemosensor for Zn^{2+} attract interest due to their short synthetic routes, high water solubility, noticeable fluorescence quantum yield and good photo-stability [10–18]. Out of the two distinctive form of fluorescein-based Schiff bases, the spirolactam (close) form is colorless and non-fluorescence. Some metal ions/species are capable to open up the ring-form accompanied with a change of its spectroscopic properties

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Declaration

There are no conflicts to declare.

Appendix A. Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.saa.2018.12.053.

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Oxyanion-Binding in a Bioinspired Nanoparticle-Assembled Hybrid Microsphere Structure: Effective Removal of Arsenate/Chromate From Water

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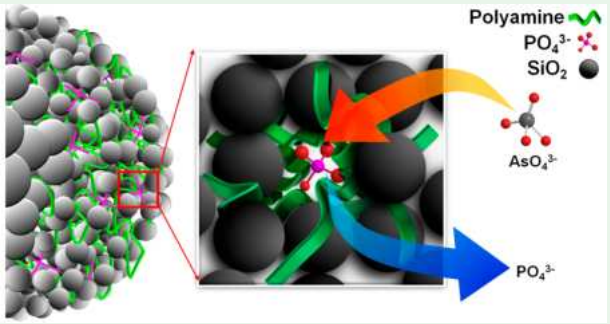
Supporting Information

ABSTRACT: We demonstrate a bioinspired assembly wherein the specific interaction of polyamines with multivalent anions allows the assembly of silica nanoparticles to generate hybrid microsphere structures while this very phenomenon further provides ways for the microspheres to adsorb oxyanions like arsenate and chromate. In a typical method based on the biomineralization of diatomaceous biosilica structure, thus produced nanoparticle-assembled microspheres with a porous structure and hybrid functionalities exhibit efficient adsorption and separation of these toxic anions from water. The adsorption follows Freundlich isotherm with an inference for stronger interaction between adsorbate and adsorbent with nonuniform distribution of adsorption affinities. The opportunities to tune the composition with respect to the multivalent anion and their interaction with the polyamine, charge ratio, and so forth, illustrate the design of bioinspired robust structures with efficient oxyanion-binding property and recyclability. The consequence of competing anions shows that the binding selectivity follows the Hofmeister series of counterion interaction. Interestingly, in accordance with a molecular imprinting mechanism, the silica nanoparticle-assembled structure stabilizes and preserves the polyamine-anion nanostructure creating cavities/voids complementary to the adsorbing ions in shape, size, and functional groups. As a result, the polyamine with phosphate as the multivalent anion exhibits efficient binding and removal of these toxic contaminants, which is better than most of the other reported adsorbents.



KEYWORDS: *biomimetic chemistry, self-assembly, nanostructures, anion-binding, ion-imprinting*

INTRODUCTION

Despite the controversial conclusions that certain bacteria can grow in the presence of arsenate instead of phosphate, there has been continuous efforts to find biological or bioinspired solutions for arsenic remediation.[1,2] This includes investigations using organisms like Microalgae (phytoplankton), which are known to be the key contributors to arsenic cycling in the marine environment.[3] Other marine organisms, such as fish and invertebrates, have also been shown to facilitate accumulation of arsenic mainly in the form of organo-arsenicals. This bioaccumulation by a number of marine organisms certainly suggests that they have an affinity for the arsenic containing compounds.[4] Although the reason underlying this biological process is still a matter of discussion, mimicking these hybrid structures may provide clues not only for the phenomenon but also for the fabrication of advanced materials for the removal of these toxic anions from water.[5] Therefore, in the present work our focus is to explore the bioinspired structures, particularly those based on the Diatoms, which represent a type of microalgae that dominate the phytoplankton blooms. Via biosilicification processes, these marine species produce shells called frustules composed of silica and long-chain polyamine-containing proteins (silaffin) assembled together generating intricately designed structures. Thus, formed hybrid structure provides controlled porosity, large surface area, and mechanical protection.[6−8] Many efforts have been made not only to understand the biosilicification process but also to help develop bioinspired methods for the synthesis of advanced materials for various desirable applications.[9−13]

In the context of the groundwater contamination, the toxic oxyanions like arsenate and chromate are known to affect millions of people globally.[14−16] According to WHO (World Health Organization) guidelines, the maximum tolerable concentrations of arsenic and chromium in drinking water are <10 and <50 ppb, respectively. Both of arsenic and chromium exist in water mainly in their tetrahedral oxyanionic form.[17,18] Therefore, the removal of these oxyanions from drinking water either through natural biogeochemical processes or engineered approaches is imperative to mitigate its potential environmental and health risk. Conventionally, it is done by absorbing the ions

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ASSESSMENT OF URBANIZATION IN CENSUS-UNITS THROUGH CONSTRUCTION OF A GENERALIZED URBANIZATION INDEX: A STUDY FOR ECONOMICALLY BACKWARD REGIONS OF WEST BENGAL DURING 1991 TO 2011

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Debasish Mondal***

Abstract

The Census Authority of India usually provides data regarding the nature of a few urbane characteristics for all the village units and thereby classifies a place as Census Town, which is considered as the lowest unit of urbanization. From the perspective of urbanization, regions of any state, consisting of blocks can be classified as economically advanced or economically backward on the basis of existence of Census Towns in it as urban places are likely to bring more prosperity in terms of standard of living. However, proper assessment of urbanization in a single measurement scale, of all village units of a particular block is not done so far. An attempt in that direction is made in this article through construction of a Generalized Urbanization Index (GUI) for all the village units of some blocks, selected through systematic-stratified sampling, from three major districts of Paschim Medinipur, Bankura and Purulia, which are known as 'so called' backward regions. The proposed GUI for a census-unit is constructed with two components - the town criteria index and the amenities index and the relative weights of both the component-indices and the underlying dimension indices are determined through the application of Iterative Average Correlation Method indicating some movement towards actuality in comparison to prevailing two other methods of weight determination - the Equal Weights Principle and the Principal Component Analysis.

***Keywords**: Urbanization, Census Town, Backward Region, Index, Equal Weights, Principal Component Analysis, Average Correlation*

***JEL Classification Codes**: C51, H54, O18*

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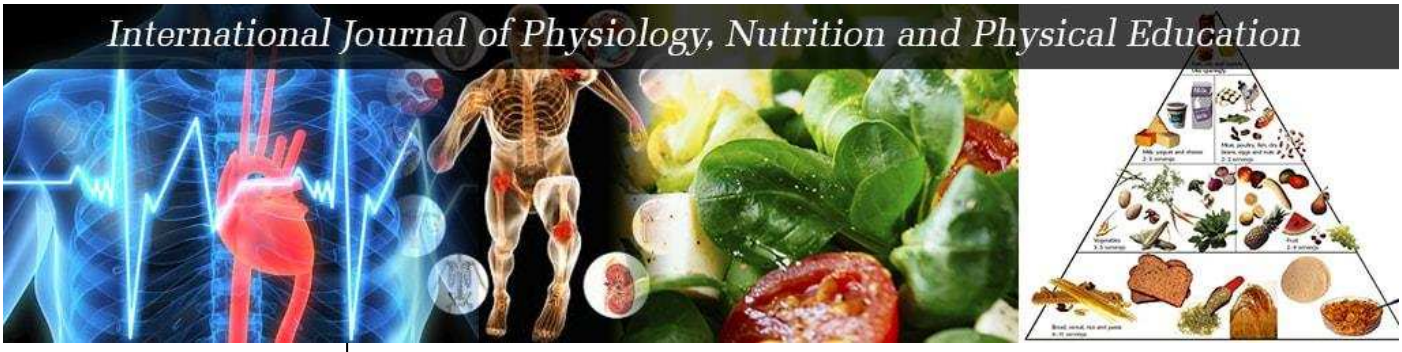
Table AT 4: Computation of AI for the Census-units in **EWP, PCA and IACM** respectively, A Representative Picture with 25 Units under 3 Censuses

Serial No.	DISTRICTS AND BLOCKS	Block-wise Serial No. in Census Years	NAME of the VILLAGE UNITS / NON-MUNICIPAL TOWNS / CENSUS TOWNS	AI (EWP)	AI (PCA)	AI (IACM)
1	**Paschim Medinipur KGP 1**	**2011 1**	ABHOYANAGAR	0.179	0.560	0.386
2	**KGP 1**	2	AGARPARA	0.061	0.170	0.134
3	**KGP 1**	3	AJABGAR	0.102	0.229	0.210
4	**KGP 1**	4	AJABPUR	0.106	0.310	0.224
5	**KGP 1**	5	AJODHYAGAR	0.153	0.548	0.369
6	**Bankura BARJORA**	**2011 1**	AMTHIA	0.062	0.160	0.128
7	**BARJORA**	2	ARJUNI	0.048	0.145	0.092
8	**BARJORA**	3	ASANSOLA	0.189	0.576	0.405
9	**BARJORA**	4	ASHURIA MADHABPUR	0.171	0.352	0.253
10	**BARJORA**	5	BAGULI	0.156	0.345	0.262
11	**Purulia KASHIPUR**	**2011 1**	ADALI	0.123	0.228	0.214
12	**KASHIPUR**	2	ADRA (CT)	0.446	0.726	0.700
13	**KASHIPUR**	3	AGARDI	0.155	0.209	0.201
14	**KASHIPUR**	4	AGRABAD	0.107	0.215	0.200
15	**KASHIPUR**	5	AGUIBAD	0.084	0.186	0.151
16	**Paschim Medinipur KGP 1**	**2001 1**	ABHOYANAGAR	0.120	0.216	0.201
17	**KGP 1**	2	AGARPARA	0.092	0.182	0.129
18	**KGP 1**	3	AJABGAR	0.048	0.056	0.074
19	**KGP 1**	4	AJABPUR	0.093	0.102	0.125
20	**KGP 1**	5	AJODHYAGAR	0.093	0.192	0.158
21	**Paschim Medinipur KGP 1**	**1991 1**	ABHOYANAGAR	0.055	0.058	0.097
22	**KGP 1**	2	AGARPARA	0.019	0.023	0.042
23	**KGP 1**	3	AJABGAR	0.036	0.035	0.055
24	**KGP 1**	4	AJABPUR	0.065	0.061	0.104
25	**KGP 1**	5	AJODHYAGAR	0.055	0.058	0.097

Source: Calculated by the Author on the basis of Selected Census Data



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Surface enhanced Raman scattering: Mechanism and suitable Nanomaterials for detection of trace molecules

Joydeb Manna

Abstract
SERS is becoming an important tool for detection of molecules in ultra-trace level. In this review, an overview of SERS and different types of SERS active substances are presented. The excessive use of metal and/or metal supported nanostructured materials have been used for making the SERS active substances. Along with pure metal nanoparticles, core-shell or hybrid nanoparticles also made their way as SERS active platform. Notably, unusual shapes such as nanostars or nanoplates have used for such purposes. Further, SERS were used for intracellular detection of biomolecules in different types of cells. It is believed that this review would be useful to further development of advanced SERS platform for various applications especially physiological detection of trace molecules.

Keywords: SERS, mechanism, Nanomaterials, intracellular, trace molecule

1. Introduction
Surface enhanced Raman spectroscopy (SERS) is a powerful vibrational spectroscopy technique that allows for highly sensitive structural detection of low concentration analytes through the amplification of electromagnetic fields generated by the excitation of localized surface plasmons [1]. SERS has progressed from studies of model systems on roughened electrodes to highly sophisticated studies, such as single molecule spectroscopy. We summarize the current state of knowledge concerning the mechanism of SERS and new substrate materials. We highlight recent applications of SERS including sensing, spectro-electrochemistry, single molecule SERS, and real-world applications. We also discuss contributions to the field from the Van Duyne group. This review concludes with a discussion of future directions for this field including biological probing with UV-SERS, tip-enhanced Raman spectroscopy, and ultrafast SERS [2]. A single metal nanoparticle typically offers SERS signal enhancements on the order of 10^2–10^6 [3]. However, when two nanoparticles are in close proximity, their dipoles can couple, leading to stronger overall field enhancements, reported to be as high as 10^{10}–10^{14} [4]. As such, nanoparticle aggregates are often considered an optimum SERS substrate, even though they lack well-defined structure [5]. For intracellular SERS imaging, these nano- particles must self-assemble into aggregates within the cell, since the aggregates are often too large to penetrate the external membrane or wall of the cell. As we shall see, the cells inherently promote this aggregation due to their primary mechanism of nanoparticle uptake; however, this can limit the access that the nanoparticles have to specific regions of the intracellular matrix.

In recent years, purposeful SERS applications have been performed by functionalizing the nanoparticles with antibodies or other bio molecules that have a special receptor [6]. The functionalized nanoparticles that also can be described as SERS targeting nanoprobes always contain Raman reporter molecules to highlight the positions of themselves by their high spectral specificity. More recently, this method has been successfully used in tumor detection on living animals [7]. However, the Raman reporter modified targeting nanoprobe provides only the signature of the reporters and tends to be an imaging instrument rather than a detection probe, like the role of a fluorescent reagent or quantum dot; the application of the latter in targeting research is already proving to be excellent. In fact, delivering molecular structural information from the target analyte is the most important characteristic or advantage of SERS, which until now has not been possible by any other technique.

Sonia *et al.* synthesized triangular nano-plates and studied their SERS effect on 4-nitrobenzenethiol (4-NBT) (Fig. 6) [17].

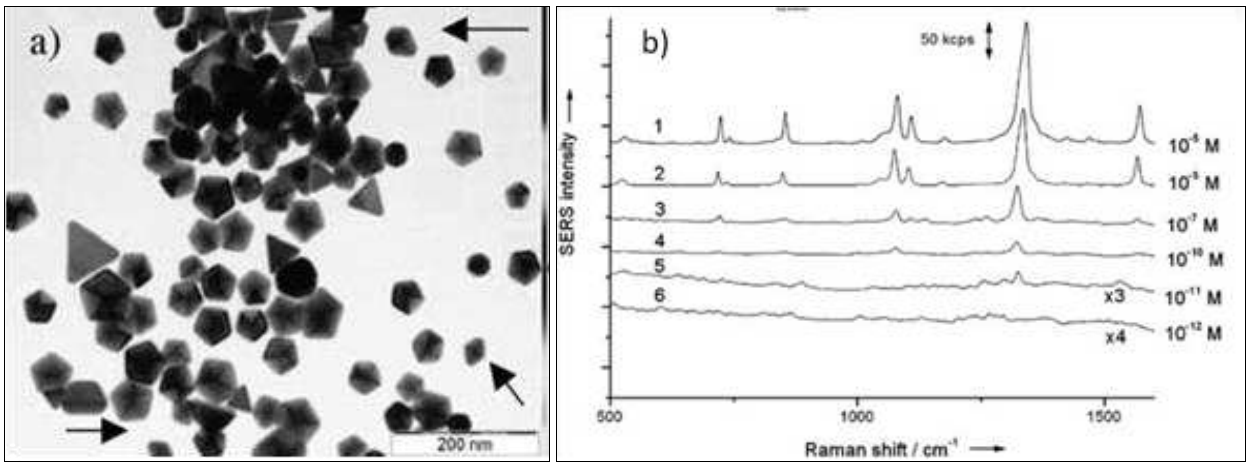

Fig 6: (a) TEM images of Au decahedra synthesized at 80 ºC in the presence of 0.8 mM T904, 30 mM citric acid 0.5 mM $HAuCl_4$ and 1 mM HCl. (b) SERS spectra obtained at different concentrations of 4-NBT in the presence of Au triangular nanoplates (1, 3–6) and Au decahedra (2) upon excitation with a 785 nm laser line [17].

5. Intra-cellular detection

There have been reports for intracellular studies using SERS activity [18, 19]. This study reports on the intracellular detection of cell constituents in mouse fibroblast cells using gold nanoshells. Gold nanoshells were acquired from Nanospectra Biosciences that are based on a silica dielectric core and an outer gold shell layer. They have the unique property of a tenable surface plasmon resonance wavelength from the visible through the near infrared which allows control of the electromagnetic field strength on its surface. Hence gold nanoshells can serve as SERS substrates with plasmonic properties that are not aggregation dependent and thus can be expected to overcome the reproducibility problem that is generally associated with aggregation based colloidal metal nanoparticles. These results represent the first steps in the development of a nano shell-based SERS probe to detect cell organelles and/or intracellular biochemicals with the goal of ultimately improving the ability to monitor intracellular biological processes in real time.

6. Conclusions

In this review, an overview of SERS and different types of SERS active substances are presented. The excessive use of metal and/or metal supported nanostructured materials have been used for making the SERS active substances. Notably, unusual shapes such as nanostars or nanoplates have used for such purposes. Further, SERS were used for intracellular detection of biomolecules in different types of cells. This review will make its use for further development of suitably functionalized SERS materials for detection of physiological trace molecules.

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EXPLOITATION OF THE NATURE AND THE TRANSFORMATION OF THE WILD IN STEPHEN ALTER'S *IN THE JUNGLES OF THE NIGHT*

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Abstract

The inclination towards human flesh as part of a daily diet is an 'unnatural' phenomenon for a predatory animal like tiger and leopard. But during the British Raj, the number of man-eaters was drastically increasing in the Kumaon and Garhwal regions of India. Strikingly, this was also the time when the rampant extraction of timber in the Terai forests saw the height of colonial exploitation. It is in this context that Stephen Alter has set his novel, In the Jungles of the Night (2016), which is included in this paper as the case-study. Alter's novel is a fictional recounting of Jim Corbett, who is depicted here as a hunter with the impulse of a naturalist and conservationist. Taking Corbett's experience in the account, as narrated by Alter in his novel, this paper would explore how man-eaters are not a natural selection, but a production of human experimentation and interference in the ecological system. How exploitation of the natural resources and encroachment in the vicinity of tigers and leopards threaten ecological balance, would also be the points of discussion for this paper. The paper would consider the colonial policies towards he wild life and investigate its role in the negative transformation of the ecosphere. Finally, the paper would draw its conclusion by reflecting upon the eco-literary consciousness in Alter's novel, suggesting how human beings can still avert ecological crisis by preserving what is left in the bio-diversity.

Keywords: Man-eater, extraction/ exploitation, encroachment, ecological crisis

In 1907 a man-eater commonly known as the Champawat tigress was shot dead by Jim Corbett. It was his first proclaimed hunting of a man-eater that had been terrorising the

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LITERARY STUDIES

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LITERARY ASSOCIATION OF NEPAL

Contents

The Mystique Mountain: Nanda Devi in the Eyes of Bill Aitken, Hugh Thomson and Stephen Alter

Asis De and Maitrayee Misra

In literature, mountains usually stand for the supra-mundane. Its vastness, its altitude, the difficulty associated with the art of mountaineering — all contribute to the stature of the mountain as something beyond the ordinary. In English literature, the trend of using mountains as literary metaphors of strength, vastness, height and challenge is a common practice. In ancient Indian (Sanskrit *Kavya* poetry) and Chinese literature (*shan-shui* poetry), mountains and mountainscapes represent mostly religio-philosophical knowledge, spiritual truth and issues transcendental amid the wilderness of nature. It is usually observed that the western treatment of mountains in literary productions chiefly rely on the spatiality of the mountainscapes whereas the oriental attitude rests on the spirituality associated with the mountains and a subtle temporality in a tangent relationship with the consciousness of the transcendental. In European/ western literary productions, the crucial truth about the treatment of mountains—whether it was the depiction of Alps or the Andes, was not at all a positive one till the 17th century! Though Marjorie Hope Nicolson, in her book *Mountain Gloom and Mountain Glory: The Development of the Aesthetics of the Infinite* (1959), observes that human "response to mountains has been influenced by inherited conventions of literature and theology" (3), there is no denying that early European literatures— written both in the Classical periods and in the Christian era, had no relation with the depiction of mountains in them. In her book, Nicolson finds the Christian era till 17th century as the period of 'Mountain Gloom', when mountains had negative depiction in literary or theological texts:

"During the first seventeen centuries of the Christian era, 'Mountain Gloom' so clouded human eyes that never for a moment did poets see mountains in the full radiance to which our eyes have become accustomed. Within a century…all this was changed. The 'Mountain Glory' dawned, then shone full splendour. Why? It was not merely a matter of literary language and conventions….The change in human attitudes about mountains involved a reversal of many basic attitudes." (3)

As Nicolson admits here, there was a certain "change in human attitudes about mountains" in the Eurocentric world of literature and academia after the seventeenth century due to "a reversal of many basic attitudes". Nicolson also cites a reference to a poem of Alexander Pope, where the poet talks about the heights of Alps and wishes climbing up:

"So pleased at first the tow'ring Alps we try,
Mount o'er the vales, and seem to tread the sky." (qtd. in Nicolson 4)

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Transnational Kinship and Diasporic 'Relatedness' in David Dabydeen's *The Intended*

Asis De

The comparatively recent notion of 'relatedness' (Jallinoja and Widmer, 2011) in family sociology, its core concept of 'relationality' and dimensions like memory and the imaginary could be seen as useful tools in measuring the changing natures of kinship and family during transnational migration. Idea like transnational kinship dwells in constant flux. Issues like ethnicity, 'race', age and language are important vectors which substantially influence both the formation and termination of kinship during transnational dislocation. To elaborate upon this point, I would use David Dabydeen's novel *The Intended*(1991) as case study, which aptly emphasizes the young protagonist's making and remaking of transnational kinship in England alongside his memories of a diasporic Indian family in Guyana and an imaginary ethnic Indian root.

"The ideas of kinship, the kin-based society, the idiom of kinship, and the content of kinship are the received wisdom of today, as they have been almost from the beginnings of anthropology"— Thus begins David Murray Schneider's highly influential volume *A Critique of the Study of Kinship* (1984), which has initiated a rather new way of looking at kinship studies beyond the formalist tradition, by attempting cross-cultural analyses of kinship only three decades back. The propositions of Schneider's new anthropology of kinship, which he finds as "the received wisdom of today", rely heavily on the nature/culture interplay than the biologically determined structuralist way of assessing kinship. The inclusion of 'local' culture/s and community history as no less elemental determinants than the exclusive factors like progeny and ethnology in kinship studies, allowed a broader and more fluid conceptualization of kinship through comparative analyses of 'relationality' of the individual with the society and its culture.Janet Carsten, another key thinker of kinship studies, in her book *After Kinship* (2004) attempts to find out how "kinship is part of the pre-given, natural order of things and the extent to which it is

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[*This paper is a revised version of a conference presentation in the Eleventh Biennial MESEA Conference (2018) on "Ethnicity and Kinship: Interdisciplinary Approaches to Family, Community, and Difference" (May 30 – June 2, 2018) hosted by University of Graz, Austria.*]

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DEPARTMENT OF ENGLISH
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The Aesthetics of Becoming a Being in Manoranjan Byapari's Bangla Dalit Autobiography *Itibritte Chandal Jivan*

Asis De

Manoranjan Byapari's *Itibritte Chandal Jivan* was published by a less-known Kolkata-based publishing house, 'ab prakashani' quite recently in January 2016. The quintessence of his life was the word that Byapari honours most—'*jijibisha*', meaning 'an extremely strong urge to live'. The first sentence of the first volume reads as: "Here I am." (*ICJ* 1: 19); the second volume ends with the sentence: "Those unexpressed words make him [the author-narrator] bleed." (*ICJ* 2: 397) [my translation]. Beginning with an emphatic 'I', which is an obvious condition of the genre, and ending with an oblique reference again to that 'I', the narrator-persona's 'bleeding' profusely due to inexpression of suffering and oppression. However, before exploring Manoranjan Byapari's two-volume autobiographical text some deliberations on the emergence of the autobiographical genre in Bengali literature and finally, of the literary space where a few personal narratives written by Dalit writers find their place is imperative.

iii Manoranjan Byapari's first ever composition, the short autobiographical piece entitled '*Rickshaw Chalai*' ('I Pull Rickshaw'), which was published in Mahasweta Devi'smagazine *Bartika* in 1981, was written under a pen-name Madan Dutta.

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