PROJECT COMPLETION REPORT

Notes:

- i. 1 soft copy of the Project Completion Report (PCR) should be sent within one monthof the completion or termination of the project.
- ii. The PCR should be in the same format. PI may, if required, submit a detailed report inbound form.
- iii. Cover page should include the title of the project; file number, names & addresses of the investigation.
- **1. Title of the project:** Theoretical investigation of Methane Oxidation Catalyzed by Metal Nanoclusters Supported on Zeolites
- 2. Principal Investigator(s) and Co-Investigator(s): Prof. Ramesh Chandra Deka
- 3. Implementing Institution(s) and other collaborating Institution(s): Tezpur University
- 4. Date of commencement: 01/10/2018
- 5. Planned date of completion: 31/09/2021
- 6. Actual date of completion: 31/03/2022
- 7. Objectives as stated in the project proposal:
- (i) To investigate structural, electronic and magnetic properties of different metal cluster using hybrid density functional methods. Stability of the clusters will be determined from their relative energies, binding energies, fragmentation energy, bond energies etc.
- (ii) DFT study will be performed in order to find out the most suitable metal cluster and the active site on that cluster for the oxidation of methane and also to investigate the adsorption of methane on the energetically most stable isomers of each of zeolite (ZSM-5, mordenite, faujasite) supported metal clusters.
- (iii) We will also investigate how zeolite support affects the ability of metal clusters to bind and activate the C-H bond of methane molecule.
- (iv) We will also optimize electronic structures of different clusters supported with zeolite material with the help of hybrid quantum mechanical/molecular mechanical method to understand the interplay between various factors that influences the properties of different metal cluster – oxidation state of the metal atoms (charge of the cluster), cluster size and interaction with the zeolite (ZSM-5, mordenite, faujasite) support.
- (v) We also perform HOMO-LUMO energy calculation in order to understand the bonding properties of the zeolite (ZSM-5, mordenite, faujasite) supported metal clusters.
- (vi) We will perform intrinsic reaction co-ordinate (IRC) calculations for different transition state involving between different supported metal clusters with co adsorbed methane and active oxygen molecule during the course of the reaction.
- (vii) Kinetics calculation will also be performed to investigate the suitable mechanism in the oxidation of methane to methanol in presence of a active oxygen species in different zeolite supported metal clusters.
- 8. Deviation made from original objectives if any, while implementing the

project andreasons thereof: No

9. Experimental work giving full details of experimental set up, methods adopted, datacollected supported by necessary table, charts, diagrams & photographs:

Computational Methodology

Density functional calculations of solid phase zeolite supported metal nanoclusters will be carried out using generalized gradient approximation with functional such as BLYP, PW91, PBE, HCTH and hybrid functional namely B3LYP, PBESOL0 etc. All electron numerical basis sets such a DNP and other Gaussian basis sets will be used for elements like H, O, C, Si, Al etc. For metals used as catalyst like Fe, Cu, Mo etc. we will use Effective Core Potential basis sets. Adsorption and interaction of adsorbates molecules CH4, H2O2 etc. will be studied on the most stable clusters of Agn. The clusters calculations will be performed using the softwares like GAMESS-UK, Gaussian 09, DMol3 etc.

(ii) The Embedded cluster calculations will be carried out with the scalar-relativistic variant of the linear combination of Gaussian-type orbitals fitting-function density functional method (LCGTO-FF-DF) as implemented in the covEPE scheme, or using the program ChemShell. The program covEPE is well suited for the proposed modeling as it has been shown with a series of applications of similar flavor some of which have already been mentioned above. The zeolite support can be modeled with the hybrid quantum mechanics / molecular mechanics (QM/MM) cluster embedding method denoted as Elastic Polarizable Environment (EPE). This method permits simultaneously high-level density functional modeling of the active site (the adsorbed metal cluster and a part of the oxide support in its vicinity) and features mechanical and electrostatic interactions between the QM region and its MM environment in mutually self-consistent fashion, even including long-range electrostatic interactions due to the Madelung field set up by distant parts of the alumina support.

- 10. Detailed analysis of results indicating contributions made towards increasing thestate of knowledge in the subject: See Annexure I
- 11. Conclusions summarizing the achievements and indication of scope for future work: See Annexure I

12. S&T benefits accrued:

SI.	Authors	Title of paper	Name of the	Volume	Pages	Year
No.			Journal			
1.	Satyajit Dey Baruah,,	Effect of single metal dopant	Chemical	717	82-86	2019
	Plaban Jyoti Sarma,	(Rh, Ru and Sn) on Pt_n^+ (n=3)	Physics Letters			
	Nand Kishor Gour,	and 4) clusters for controlled				
	and Ramesh Chandra	CO tolerance				
	Deka					
2.	Nishant Biswakarma,	Catalytic Oxidation of NO on	Journal of	124	3059-	2019
	Plaban Jyoti Sarma,	[Au-M] (M=Pd and Pt)	Physical		3068	
	Satyajit Dey Baruah,	Bimetallic Dimers: An	Chemistry C			
	Nand Kishor Gour*	insight from Density				
	and Ramesh Chandra	Functional Theory Approach				
	Deka					
3.	Plaban Jyoti Sarma,	Tuning the transition barrier	Physical	23(1)	204-210	2020
	Dikshita Dowerah,	of H_2 dissociation in the	Chemistry			
	Nand K. Gour and	hydrogenation of CO ₂ to	Chemical			

i. List of Research publications:

	Ramesh Ch, Deka	formic acid on Ti-doped Sn ₂ O ₄ cluster	Physics			
4.	Satyajit Dey Baruah, Subrata Paul, Nand Kishor Gour, Nishant Biswakarma and Ramesh Chandra Deka	Mechanism and Kinetics of Catalytic Oxidation of CO to CO_2 over Pt_n^+ and MPt_{n-1}^+ , (M=Sn, Rh &Ru n=3, 4) Clusters	Molecular Catalysis	509	111638	2021
5.	Nishant Biswakarma, Dikshita Dowerah, Satyajit Dey Baruah, Plaban Jyoti Sarma, Nand Kishor Gour, Ramesh Chandra Deka	Catalytic oxidation of NO to NO ₂ on pure and doped Au _n Pt _{3-n} (n= 0–3) clusters: A DFT perspective	Molecular Catalysis	515	111910	2021
6.	Partha Pratim Churi, Nishant Biswakarma, Dikshita Dowerah, Shilpa Neog, Plaban Jyoti Sarma, Nand Kishor Gour, Ramesh Chandra Deka	Structure and Stability of $(CeO_2)_n^{0,\pm 1}$ (n= 1-3) Clusters towards the Adsorption and Co-adsorption of CO and H2O from DFT Study	Chemical Physics Impact	6	100125	2023

ii. Manpower trained on the project

- a) Research Scientists or Research Associates: 1
- b) No. of Ph.D. produced:4
- c) Other Technical Personnel trained: No
- iii. Patents taken, if any: None

13. Financial Position:

No	Financial Position/ Budget Head	Funds Sanctioned	Expenditure	% of Total cost
I	Salaries/ Manpower costs	Rs 24,55,200/-	Rs 22,11,000/-*	
	Equipment	Rs 19,95,800/-	Rs 20,33,425/-	
	Supplies & Materials			
IV	Contingencies	Rs, 1,50,000/-	Rs 52,941/-	
V	Travel	Rs, 1,50,000/-	Rs 21,101/-	
VI	Overhead Expenses	Rs, 4,50,000/-	Rs 1,80,023/-	
VII	Others, if any			
	Total	Rs 52,01,000/-	Rs 44,98,490/-	100%

* This expenditure includes arrear amount which increased w.e.f 01/01/2019. An amount of Rs 4,05,600/- is required for Manpower costs.

14. Procurement/ Usage of Equipment

a)

S No	Name of Equipment	Make/Model	Cost (FE/ Rs)	Date of Installation	Utilisatio n Rate (%)	Remarks regarding maintenance/ breakdown
1.	High Performance	HPE: Serial No.	Rs 20,33,425/-	19 th August	100%	
	Computing	SGH924TGX3		2019		
	Clusters	Product No. 867959-				
		B21				
		Manufacturing				

	Tracking Label	
	iLO: User Name: Administrator	
	DNS: ILOSGH924TGX3	
2.		

b) Plans for utilising the equipment facilities in future

High Performance Computing Cluster is still working and in well condition. This cluster is very helpful for our PhD scholars to perform higher level quantum calculation and molecular dynamics simulation. Integrated M.Sc. /M.Sc. students as well as internship students are also utilizing the cluster for doing quantum calculations. We hope this cluster will be very helpful in future.

ROKA (RAMESH QI. DE KA) Name and Signature with Date 24/03/2023

R.C.DEKA (Principal Investigator) a.

b.

(Co-Investigator)

Annexure 1

Progress Report

In this work, we are presenting a computational study on the impact of oxygen, energy, and the methane-to-methanol alteration method using the Pd_4 catalyst. Pd_4 cluster is one of the most stable clusters and therefore, it is important to study the methane oxidation on Pd_4 cluster. Metal atoms and clusters act as an ideal platform for mechanism study at the atomic level. Moreover, it also enables us to explore the chemistry behind the interaction of catalytic site with the adsorbate molecules. Furthermore, cluster research on the reaction scheme of methane to methanol transformation is quite restricted. Hence, our main goal in this work is to find out the effect of the Pd_4 on the mechanism of methane to methanol change.

Methodology

To get the lowest energy structures and thermo-chemical characterization of the species included within the reaction mechanism, Kohn-Sham density functional theory (DFT) is utilized in Gaussian 09 software package. For frequency calculations and geometry relaxation, a hybrid B3PW91 functiona is selected which is the combination of Becke 3 exchange functional and Perdew Wang (PW91) correlation functional. LANL2DZ basis set is used to describe Pd clusters whereas 6-31G basis set is used for main group atoms. Vibrational frequency calculations are performed to recognize between a minima {number of imaginary frequencies (NIMAG=0) and a first order maxima (NIMAG=1)}. IRC calculations have been performed to verify the reliability of the reaction path. The binding energy (BE) can be calculated as

$$B.E. = E_{Pd_40} + E_{CH_4} - E_{Pd_40/CH_4}$$
(1)

where E_{Pd_4O} represents the total zero-point corrected energy of the Pd₄O, E_{CH_4} is the total zeropoint corrected energy of the CH₄ molecule and E_{Pd_4O/CH_4} is the total zero-point corrected energy of the CH₄ adsorbed on Pd₄O dimer.

Results and discussion

 Pd_4 cluster is oxidized by one of the oxidizing agents, N_2O forming Pd_4O . Nitrous oxides (N_2O) are detrimental greenhouse gases responsible for acid rain, smog formation and global warming. Its global warming potency is greater than that of CO_2 in a broader range of time.

Therefore, converting it to a harmless N_2 gas is a crucial step. N_2O interacts with Pd_4 , forming another important intermediate $[Pd_4O]$ and converting itself to N_2 . Decomposition of N_2O occurs via Transition state TS1. It is important to note that $[Pd_4O]$ is a key species as methane interacts with $[Pd_4O]$ species forming reactant complex. Adsorbed O in Pd_4 goes from linear to bridged position via TS2. Methane to methanol reaction pathway proceeds in a three-step manner via three transition states (TS3, TS4 and TS5). Going further, the O^2 -(Oxo) species is inserted into C-H bond of methane via Transition state TS3. OH migrates to its neighboring Pd atom where CH₃ moiety is present via TS4. Recombination of the CH₃ and OH moiety results in the formation of the product complex via transition state TS5. At the end, methanol is removed, thus leaving Pd_4 as a catalyst. The cyclic process restarts again when the oxidizing agents donates O atom to Pd_4 forming [Pd_4O].



Scheme 1: Possible catalytic cycle for methane to methanol conversion by Pd₄ cluster

Reaction mechanism and kinetics of catalytic conversion of methane to methanol on bare Pd₄ cluster

The detailed proposed mechanism shown in scheme 1 determines that first Pd_4 cluster is oxidized using N₂O which transfer its O atom to Pd_4 cluster, forming Pd_4O cluster and converting itself to N₂. After formation of $[Pd_4O]$ catalyst, methane to methanol reaction pathway proceeds in a three-step manner where the first step includes C-H activation, second step includes migration of OH group and third step includes recombination of CH₃ and OH group to form methanol. Pd₄ has tetrahedral structure (T_d). Although the stability of triplet spin state Pd_4 is higher than that of singlet state, N₂O adsorption is found to be favorable in case of singlet spin state. N₂O binds to one of the Pd atoms via its N atom which leads to higher adsorption energies. Then O atom of N₂O rearranges itself to binds with one of the neighboring Pd atom, resulting in the cleaving of N-O bond via TS1. The stretching of N-O bond (1.744 Å) confirms the breaking of N-O bond to form N₂ and O atoms. The imaginary frequency for the transition state is 347.16*i*. In IM2, O atom is in linear position with Pd₄ atoms and N₂ molecule is formed. In the next step, N₂ is released leading to the formation of [Pd₄O] species (IM3) which is important for methane conversion. Going forward, linear Pd₄O cluster rearranges to form bridged Pd₄O cluster via TS2 (121.25*i*). IM4 is formed where O atom is in bridged position in Pd₄O.



Figure 1: Optimized geometries of intermediates and transition states for oxidation of Pd_4 to $[Pd_4O]$ at B3PW91/LANL2DZ level of theory.

IM4 interacts with CH₄ to form IM5 where one H atom is interacting with one of the Pd atoms which is evident from the elongation of C-H atom (1.119 Å). C-H activation takes place via TS3 where one H atom migrates from CH₄ to O atom of Pd clusters. The activation of C-H bond is validated looking at its bond lengths increasing from 1.119 Å to 1.406 Å. The imaginary frequency of TS3 is 1538.28*i*. In IM6, O-H moiety is in bridged position in between two Pd atoms. The next step in the reaction is the migration of OH group from bridging position to the Pd atom where CH₃ group is already present. This step is validated via Transition state TS4 (160.64*i*). In TS5, recombination of CH₃ and OH group occurs to form methanol. In IM8, methanol is attached to the cluster via its O atom. Methanol is desorbed from IM8, recycling the original catalyst Pd₄ and the formation of methanol.



Figure 2: Optimized geometries of intermediates and transition states for oxidation CH_4 to CH_3OH on Pd_4O at B3PW91/6-31G/LANL2DZ level of theory.

Finally, we have obtained the values of the Gibbs' free energies of all the species as given in the reaction mechanism along with intermediates and transition states. We have plotted the potential energy profile diagram for the reaction of Pd_4 with N_2O+CH_4 , which is shown in Figure 3.



Figure 3: Potential energy diagram for catalytic pathway of N_2O+CH_4 on Pd₄ at the B3PW91/6-31G/LANL2DZ level of theory.

We have calculated relative Gibbs' free energies for all species with respect to $Pd_4 + N_2O + CH_4$ (gas) at 298 K and 1 atm. First part of the reaction mechanism is to oxidize Pd_4 cluster to Pd_4O using N_2O . N_2O is adsorbed to Pd_4 forming IM1 which has energy equal to -5.57 kcal/mol, lower than the starting species. Reaction proceeds further via TS1 where one of the Pd atom interacts with O atom of N_2O , cleaving N-O bond in N_2O , thus, leading to the formation of IM2. This step is spontaneous which can be seen from the relative energy of IM2 with respect to IM1. IM2 is -16.83 kcal/mol lower than the starting material. The barrier height for this reaction step is 5.77 kcal/mol which is quite low. After that, N_2 is released which lead to the formation of IM3.

Linear O atom in Pd₄ goes to more stable bridged position of Pd₄ via TS2. The energy barrier is very low which is 2.41 kcal/mol. CH₄ interacts with IM4 to form IM5 which is -40.14 kcal/mol in energy with respect to the starting point. C-H activation occurs via TS3 where one H atom interacts with O atom of Pd₄ cluster. The activation barrier for C-H activation is 33.77 kcal/mol. The step is slightly endothermic. Reaction proceeds forward where bridged O-H group migrates to Pd atom where CH₃ moiety is present. This step goes through TS4 which has activation barrier of about 8.87 kcal/mol. The last step is the recombination of CH₃ and OH, resulting in the formation of methanol, which has a barrier height of 28.94 kcal/mol. This step is exothermic and the overall process is spontaneous.

Reaction mechanism and kinetics of catalytic conversion of methane to methanol on ZSM-5 supported Pd₄ cluster

We have taken a MFI fragment with 132 atoms as a support for cluster with 11 atoms in the QM region and the rest atoms in the MM region using UFF force field. Similar to the bare cluster, N_2O adsorption is more favorable in the singlet spin state of MFI supported Pd_4 . The mechanistic pathway for the supported cluster has been shown in the singlet spin state.











TS4 (122.09*i*)

IM6



Figure 4: Optimized geometries of intermediates and transition states for oxidation CH_4 to CH_3OH on Pd_4 at B3PW91/6-31G/LANL2DZ level of theory.

N₂O binds to one of the Pd atoms via its N atom which leads to higher adsorption energies. Then O atom of N₂O rearranges itself to binds with one of the neighboring Pd atom, resulting in the cleaving of N-O bond via TS1. The stretching of N-O bond (1.88 Å) confirms the breaking of N-O bond to form N₂ and O atoms. The strengthening of Pd-O bond can be shown via shortening of the bond from 2.03 Å to 1.89 Å. The imaginary frequency of the transition state is 111.63*i*. In IM2, N₂ and O atom are co-adsorbed in the Pd₄ cluster supported in ZSM-5. N₂ is released from the system which results in the formation of IM3. In TS2, linear O atom of Pd₄ acquire bridged configuration via negative frequency 167.28*i*. Now, methane enters the system and interacts with the ZSM-5_Pd4 cluster which results in the formation of IM5. Methane interaction is small which can be seen from the bond distance 3.63 Å. C-H activation occurs via TS3 where elongation of C-H bond upto 1.41 Å took place. The one negative frequency is 1543.07*i*. In IM6, O-H moiety is bridged between two Pd atoms. The last transition state is the migration of OH group from one Pd to another Pd atom where CH3 group is present. This TS results in the formation of methanol. IM7 is the interaction of methanol with the zeolite supported Pd₄ cluster.

We have obtained the values of the Gibbs' free energies of all the species as given in the reaction mechanism along with intermediates and transition states. We have plotted the potential energy profile diagram for the reaction of ZSM-5_Pd₄ with N_2O+CH_4 , which is shown in Figure 5.



Figure 5: Potential energy diagram for catalytic pathway of N_2O+CH_4 on ZSM-5 supported on Pd₄ at the B3PW91/6-31G/LANL2DZ level of theory.

In a similar fashion to that of bare clusters, we have also calculated relative Gibbs' free energies for all species with respect to ZSM-5_Pd₄ + N₂O + CH₄ (gas) at 298 K and 1 atm. Interaction of N₂O with ZSM-5_Pd₄ results in the formation of IM1 which is -1.36 kcal/mol in energy than the starting point. TS1 results in breaking of N₂O to form ZSM-5_Pd₄O cluster and N₂ molecule. The activation barrier is 2.86 kcal/mol for the dissociation step of N₂O. The step is exothermic by 3.15 kcal/mol. N₂ is released from the system which results in the formation of IM3 which is much more exothermic with respect to IM2. In TS2, O atom which is linear position in Pd₄ cluster goes to bridged position. The barrier height for this step is 2.10 kcal/mol. The bridged O atom in the cluster is much more stable which is evident from the potential energy surface diagram. The IM4 is -52.25 kcal/mol lower in energy than the starting point. CH_4 interacts with IM4 to form IM5 which is slightly higher in energy than -40.69 kcal/mol. C-H activation occurs via TS3 which has energy barrier of about 21.75 kcal/mol. The reaction proceeds via IM6 where CH_3 and O-H moiety are formed and attached to the cluster. O-H group which is in bridged position migrates towards Pd atom where CH_3 moiety is already present. This step has barrier height of about 16.82 kcal/mol. At last, recombination of CH_3 and OH group occurs in the same Pd atom results in the formation of methanol. The last step has activation barrier of 32.91 kcal/mol. The barrier height for the bare and ZSM-5 supported Pd₄ cluster for each step has been shown in Table 1.

Reactants	TS1	TS2	TS3	TS4	TS5
Pd ₄ +CH ₄ +N ₂ O	5.77	2.41	33.77	8.87	28.94
MFI_Pd ₄ +CH ₄ +N ₂ O	2.86	2.10	21.75	16.82	32.91

This work examines the catalytic oxidation of CH₄ to CH₃OH on bare and ZSM-5 supported Pd₄ cluster, in brief. The first part of the reaction includes where oxidation of the catalyst took place using N₂O. Then, the conversion of methane to methanol starts on the oxidized [Pd₄O] where reaction pathway is observed to proceed where the $O^{2-}(Oxo)$ species is inserted into C-H bond of methane and recombination of CH₃ and OH moiety occurs, resulting in the formation of methanol. Adsorption and dissociation of N₂O on Pd₄ cluster lead to the oxidized metal cluster Pd₄O. Pd₄O where atomic oxygen is bonded in bridge fashion is more stable compared to Pd₄O [IM3] where atomic oxygen is linearly bonded to one Pd atom. In case of MFI_Pd₄, the energy barrier for the transition states, mainly the N₂O dissociation and C-H activation is lowered by 2.91 and 12.02 kcal/mol. However the O transfer in the Pd₄ cluster and the recombination step of OH and CH₃ has lower energy barrier in bare Pd₄ cluster. This work gives an insight into the adsorption and reaction for the improvement of the hydroxylation of methane by [Pd₄O]. Moreover, it provides an opportunity to explore the interaction process at atomistic level, which will aid experimentalists in developing efficient catalysts on a large scale.

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2018-19 in respect of NON- RECURRING

as on 31.03.2019 to be submitted to DST

The UC is Audited (To be given separately for each financial year ending on 31st March)

- 1. Name of the grant receiving Organization : Tezpur University, Napaam, India
- 2. Name of Principal Investigator (PI) : Prof. Ramesh Ch. Deka

3. DST Sanction order no. & date : SR/NM/NS-1147/2016(G), dated 20/08/2018

- 4. Title of the Project: Theoretical investigation of Methane oxidation catalyzed by metal nanoclusters supported on zeolites.
- 5. Name of the Scheme : DST Nano Mission
- 6. Whether recurring or non-recurring grants : Non-Recurring
- 7. Grants position at the beginning of the Financial year (Grants released by DST)
 - (i) Cash in Hand/Bank /Carry forward from previous financial year : Nil
- (ii) Others, If any

: Nil

: Nil (Bank interest on non-recurring grant)

(iii) Total

8. Details of grants received, expenditure incurred and closing balances: (Actuals)

Unspent Balance of Grants received previous years [figure as at Sl. No. 7(iii)]	Interest Earned thereon	Interest deposited back to the Government	Grants received during the year 2018-19		Total Available funds (1+2-3+4)	Expenditure incurred	Closing Balances (5-6)	
1	2	3		4		5	6	7
			Sanction No. (i)	Date (ii)	Amount (iii)			
Nil	NA	NA	SR/NM/NS- 1147/2016(G)	20/08/2018	₹19,95,800/-	₹ 19,95,800/-	Nil	*₹ 19,95,800/-

* The amount has been committed for the purchase of equipments

Component wise utilization of grants:

Grants-in-aid- General	Grant-in-aid-creation for capital assets	Total
	Nil	Nil

Details of grants position at the end of the year

Unadjusted Advances

(v)

(iv)	Cash in Hand/Bank	: ₹ 19,95,800/-
(iv)	Cash in Hand/Bank	

: Nil

(vi) Balance (Carry forward to next financial year)

: ₹ 19,95,800/- (The amount has been committed for the purchase of equipments)

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2018-19 in respect of NON-RECURRING as on 31.03.2019 to be submitted to DST The UC is Audited

(To be given separately for each financial year ending on 31st March)

Certified that I have satisfied that the conditions on which grants were sanctioned have been duly fulfilled/are being fulfilled and that I have exercised following checks to see that the money has been actually utilized for the purpose for which it was sanctioned:

- (i) The main accounts and other subsidiary accounts and registers (including assets registers) are maintained as prescribed in the relevant Act/Rules/Standing instructions (mention the Act/Rules) and have been duly audited by designated auditors. The figures depicted above tally with the audited figures mentioned in financial statements/accounts.
- (ii) There exist internal controls for safeguarding public funds/assets, watching outcomes and achievements of physical targets against the financial inputs, ensuring quality in asset creation etc. & the periodic evaluation of internal controls is exercised to ensure their effectiveness.
- (iii) To the best of our knowledge and belief, no transactions have been entered that are in violation of relevant Act/Rules/standing instructions and scheme guidelines.
- (iv) The responsibilities among the key functionaries for execution of the scheme have been assigned in clear terms and are not general in nature.
- (v) The benefits were extended to the intended beneficiaries and only such areas/districts were covered where the scheme was intended to operate.
- (vi) The expenditure on various components of the scheme was in the proportions authorized as per the scheme guidelines and terms and conditions of the grants-in-aid.
- (vii) It has been ensured that the physical and financial performance under DST Nano Mission (Name of the scheme has been according to the requirements, as prescribed in the guidelines issued by Govt. of India and the performance/targets achieved statement for the year to which the utilization of the fund resulted in outcomes given at Annexure – I duly enclosed.
- (viii) The utilization of the fund resulted in outcomes given at Annexure-II duly enclosed (to be formulated by the Ministry/Department concerned as per their requirements/specifications.)
- (ix) Details of various schemes executed by the agency through grants-in-aid received from the same Ministry or from other Ministries are enclosed at Annexure–II (to be formulated by the Ministry/Department concerned as per their requirements/specifications).

Date: 02/07/2020 Place: Signature with Seal: Signature of PI Signature with Seal..... Name: Name: **Chief Finance Officer** (Head of Finance) Head of Organisation Finance Officer Registrar Tezpur University Tespur University

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2019-20 in respect of NON- RECURRING as on 31.03.2020 to be submitted to DST

The UC is Audited (To be given separately for each financial year ending on 31st March)

1. Name of the grant receiving Organization : Tezpur University, Napaam, India

2. Name of Principal Investigator (PI) : Prof. Ramesh Ch. Deka

3. DST Sanction order no. & date : SR/NM/NS-1147/2016(G), dated 20/08/2018

4. Title of the Project: Theoretical investigation of Methane oxidation catalyzed by metal nanoclusters supported on zeolites.

5. Name of the Scheme : DST Nano Mission

6. Whether recurring or non-recurring grants: nonrecurring

7. Grants position at the beginning of the Financial year (Grants released by DST)

(i) Cash in Hand/Bank /Carry forward from previous financial year : ₹. 19,95,800/-

(ii) Others, If any

: Nil (Bank interest on non-recurring grant)

(iii) Total

: ₹. 19,95,800/-

8. Details of grants received, expenditure incurred and closing balances: (Actuals)

Unspent Balance of Grants received previous years [figure as at Sl. No. 7(iii)]	Interest Earned thereon	Interest deposite d back to the Govern ment	Grants received during the year 2019-2020			Total Available funds (1+2-3+4)	Expenditure incurred	Closing Balances (5-6)
1	2	3		4		5	6	7
			Sanction No. (i)	Date (ii)	Amount (iii)			
₹19,95,800/-	NA	NA	Nil	Nil	Nil	₹ 19,95,800/-	₹ 20,33,425/-	-*₹37,625/-

*The negative amount has been adjusted from the overhead expenses

Component wise utilization of grants:

Grants-in-aid- General	Grant-in-aid-creation for capital assets	Total	
	₹ 20,33,425/-	₹ 20,33,425/-	

Details of grants position at the end of the year

(iv) Cash in Hand/Bank :-₹37,625/-

(v) Unadjusted Advances : NIL

(vi) Balance (Carry forward to next financial year)

: -₹37,625/- (Negative amount has been adjusted from the overhead expenses)

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2019-20 in respect of NON-RECURRING as on 31.03.2020 to be submitted to DST The UC is Audited (To be given separately for each financial year ending on 31st March)

Certified that I have satisfied that the conditions on which grants were sanctioned have been duly fulfilled/are being fulfilled and that I have exercised following checks to see that the money has been actually utilized for the purpose for which it was sanctioned:

- (i) The main accounts and other subsidiary accounts and registers (including assets registers) are maintained as prescribed in the relevant Act/Rules/Standing instructions (mention the Act/Rules) and have been duly audited by designated auditors. The figures depicted above tally with the audited figures mentioned in financial statements/accounts.
- (ii) There exist internal controls for safeguarding public funds/assets, watching outcomes and achievements of physical targets against the financial inputs, ensuring quality in asset creation etc. & the periodic evaluation of internal controls is exercised to ensure their effectiveness.
- (iii) To the best of our knowledge and belief, no transactions have been entered that are in violation of relevant Act/Rules/standing instructions and scheme guidelines.
- (iv) The responsibilities among the key functionaries for execution of the scheme have been assigned in clear terms and are not general in nature.
- (v) The benefits were extended to the intended beneficiaries and only such areas/districts were covered where the scheme was intended to operate.
- (vi) The expenditure on various components of the scheme was in the proportions authorized as per the scheme guidelines and terms and conditions of the grants-in-aid.
- (vii) It has been ensured that the physical and financial performance under DST Nano Mission (Name of the scheme has been according to the requirements, as prescribed in the guidelines issued by Govt. of India and the performance/targets achieved statement for the year to which the utilization of the fund resulted in outcomes given at Annexure – I duly enclosed.
- (viii) The utilization of the fund resulted in outcomes given at Annexure-II duly enclosed (to be formulated by the Ministry/Department concerned as per their requirements/specifications.)
- (ix) Details of various schemes executed by the agency through grants-in-aid received from the same Ministry or from other Ministries are enclosed at Annexure–II (to be formulated by the Ministry/Department concerned as per their requirements/specifications).

Date: 02/07/2020 Place: / Jespur Signature of PI : Signature with Seal: ... Signature with Seal 0 Name: Name: . Registrar **Chief Finance Officer** Tezpus of Organisation (Head of Finance) Finance Officer Tespur University

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2020-2021 in respect of NON- RECURRING as on 31.03.2021 to be submitted to DST The UC is Audited (To be given separately for each financial year ending on 31stMarch)

1. Name of the grant receiving Organization : Tezpur University, Napaam, India

2. Name of Principal Investigator (PI):Prof. Ramesh Ch. Deka

3. DST Sanction order no. & date :SR/NM/NS-1147/2016(G), dated 20/08/2018

4. Title of the Project: Theoretical investigation of Methane oxidation catalyzed by metal nanoclusters supported on zeolites.

5. Name of the Scheme : DST Nano Mission

1

6. Whether recurring or non-recurring grants:nonrecurring

7. Grants position at the beginning of the Financial year (Grants released byDST)

(i)	Cash in Hand/Bank /Carry forward from previous financial year	: -₹37,625/-	

- (ii) Others, Ifany : Nil (Bank interest on non-recurring grant)
- (iii) Total :-₹37,625/-

8. Details of grants received, expenditure incurred and closing balances:(Actuals)

Unspent Balance of Grants received previous years [figure as at SI. No. 7(iii)]	Interest Earned thereon	Interest deposited back to the Government	Grants received during the year 2019-2020		Total Available funds (1+2-3+4)	Expenditre incurred	Closing Balances (5-6)	
1	2	3		4		5	6	7
			Sanction No. (i)	Date (ii)	Amount (iii)			
-₹37,625/-	NA	NA	Nil	Nil	Nil	-₹37,625/-	Nil	-*₹37,625/-

*The negative amount has been adjusted from the overhead expenses

Component wise utilization of grants:

Grants-in-aid- General	Grant-in-aid-creation for capital assets	Total
	Nil	Nil

Details of grants position at the end of the year

(iv) Cashin Hand/Bank

:-₹37,625/-

- (v) Unadjusted Advances : NIL
- (vi) Balance (Carry forward to nextfinancialyear)

:-₹37,625/-(Negative amount has been adjusted from the overhead expenses)

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2020-2021 in respect of NON-RECURRING as on 31.03.2021 to be submitted to DST The UC is Audited (To be given separately for each financial year ending on 31stMarch)

Certified that I have satisfied that the conditions on which grants were sanctioned have been duly fulfilled/are being fulfilled and that I have exercised following checks to see that the money has been actually utilized for the purpose for which it was sanctioned:

- (i) The main accounts and other subsidiary accounts and registers (including assets registers) are maintained as prescribed in the relevant Act/Rules/Standing instructions (mention the Act/Rules) and have been duly audited by designated auditors. The figures depicted above tally with the audited figures mentioned in financialstatements/accounts.
- (ii) There exist internal controls for safeguarding public funds/assets, watching outcomes and achievements of physical targets against the financial inputs, ensuring quality in asset creation etc. & the periodic evaluation of internal controls is exercised to ensure theireffectiveness.
- (iii) To the best of our knowledge and belief, no transactions have been entered that are in violation of relevant Act/Rules/standing instructions and schemeguidelines.
- (iv) The responsibilities among the key functionaries for execution of the scheme have been assigned in clear terms and are not general innature.
- (v) The benefits were extended to the intended beneficiaries and only such areas/districts were covered where the scheme was intended tooperate.
- (vi) The expenditure on various components of the scheme was in the proportions authorized as per the scheme guidelines and terms and conditions of thegrants-in-aid.
- (vii) It has been ensured that the physical and financial performance underDST Nano Mission(Name of the scheme has been according to the requirements, as prescribed in the guidelines issued by Govt. of India and the performance/targets achieved statement for the year to which the utilization of the fund resulted in outcomes given atAnnexure-I duly enclosed.
- (viii) The utilization of the fund resulted in outcomes given at Annexure-II duly enclosed (to be formulated by the Ministry/Department concerned as per theirrequirements/specifications.)
- (ix) Details of various schemes executed by the agency through grants-in-aid received from the same Ministry or from other Ministries are enclosed at Annexure–II (to be formulated by the Ministry/Department concerned as per their requirements/specifications).

Date: 9/4/202/ Place: JEZAWA Signature with Seal: Signature with Seal... Name: _____ Name:.... Chief Finance Officer (Head of Finance) **Head of Organisation** Finance Ufficer Registrar Tezpur University Terpur University

GFR 12 – A [(See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2021-2022 in respect of NON- RECURRING as on 31.03.2022 to be submitted to DST The UC is Audited (To be given separately for each financial year ending on 31stMarch)

1. Name of the grant receiving Organization : Tezpur University, Napaam, India

2. Name of Principal Investigator (PI):Prof. Ramesh Ch. Deka

3. DST Sanction order no. & date :SR/NM/NS-1147/2016(G), dated 20/08/2018

4. Title of the Project: Theoretical investigation of Methane oxidation catalyzed by metal nanoclusters supported on zeolites.

- 5. Name of the Scheme : DST Nano Mission
- 6. Whether recurring or non-recurring grants:nonrecurring
- 7. Grants position at the beginning of the Financial year (Grants released by DST)
 - (i) Cash in Hand/Bank /Carry forward from previous financial year : Nil
 - (ii) Others, If any : Nil (Bank interest on non-recurring grant)
 - (iii) Total : Nil

8. Details of grants received, expenditure incurred and closing balances:(Actuals)

Unspent Balance of Grants received previous years [figure as at SI. No. 7(iii)]	Interest Earned thereon	Interest deposited back to the Government	Grants	Grants received during the year 2019-2020		Total Available funds (1+2-3+4)	Expenditre incurred	Closing Balances (5-6)
1	2	3		4		5	6	7
			Sanction No. (1)	Date (ii)	Amount (iii)			
Nil	NA	NA	Nil	Nil	Nil	Nil	Nil	Nil

*The negative amount has been adjusted from the overhead expenses

Component wise utilization of grants:

Grants-in-aid- General	Grant-in-aid-creation for capital assets	Total
	Nil	Nil

Details of grants position at the end of the year

 (iv)
 Cashin Hand/Bank
 :Nil

 (v)
 Unadjusted Advances
 : NIL

(vi) Balance (Carry forward to nextfinancialyear) :Nil

GFR 12 – A [[See Rule 238 (1))] UTILIZATION CERTIFICATE (UC) FOR THE YEAR 2021-2022 in respect of NON-RECURRING as on 31.03.2022 to be submitted to DST The UC is Audited (To be given separately for each financial year ending on 31stMarch)

Certified that I have satisfied that the conditions on which grants were sanctioned have been duly fulfilled/are being fulfilled and that I have exercised following checks to see that the money has been actually utilized for the purpose for which it was sanctioned:

- (i) The main accounts and other subsidiary accounts and registers (including assets registers) are maintained as prescribed in the relevant Act/Rules/Standing instructions (mention the Act/Rules) and have been duly audited by designated auditors. The figures depicted above tally with the audited figures mentioned in financialstatements/accounts.
- (ii) There exist internal controls for safeguarding public funds/assets, watching outcomes and achievements of physical targets against the financial inputs, ensuring quality in asset creation etc. & the periodic evaluation of internal controls is exercised to ensure their effectiveness.
- (iii) To the best of our knowledge and belief, no transactions have been entered that are in violation of relevant Act/Rules/standing instructions and schemeguidelines.
- (iv) The responsibilities among the key functionaries for execution of the scheme have been assigned in clear terms and are not general innature.
- (v) The benefits were extended to the intended beneficiaries and only such areas/districts were covered where the scheme was intended tooperate.
- (vi) The expenditure on various components of the scheme was in the proportions authorized as per the scheme guidelines and terms and conditions of thegrants-in-aid.
- (vii) It has been ensured that the physical and financial performance underDST Nano Mission(Name of the scheme has been according to the requirements, as prescribed in the guidelines issued by Govt. of India and the performance/targets achieved statement for the year to which the utilization of the fund resulted in outcomes given atAnnexure-I duly enclosed.
- (viii) The utilization of the fund resulted in outcomes given at Annexure–II duly enclosed (to be formulated by the Ministry/Department concerned as per theirrequirements/specifications.)
- (ix) Details of various schemes executed by the agency through grants-in-aid received from the same Ministry or from other Ministries are enclosed at Annexure–II (to be formulated by the Ministry/Department concerned as per their requirements/specifications).

14/2022 Date: 7

Place: Ternur

Signature of PI : Signature with Seal. Name:.... Prof. Ramesh Ch. Deka Chief Finance Officer Department of Chemical Sciences School of Science and Technology (Head of Finance) Head of Organisation Registrar Tezpur University Finance Ufficer Napaam- 784028 : Tezpur : Assam Tespur University Terpur University

Annexure-II

REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT OF EXPENDITURE (April 2018 - March 2019)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated: 20.08.2018
2.	Name of the PI	: Prof. Ramesh Ch. Deka
3.	Total Project Cost	:₹. 52,01,000/-
4.	Revised Project Cost	: N/A
5	(If applicable) Date of Commencement	: 01.10.2018

Statement of Expenditure: 6.

(Month wise expenditure incurred during the current financial year)

Month & Year	Expenditure incurred
April 2018	₹. 0.00/-
May. 2018	₹. 0.00/-
June, 2018	₹. 0.00/-
July, 2018	₹. 0.00/-
August, 2018	₹. 0.00/-
September, 2018	₹. 0.00/-
October, 2018	₹. 0.00/-
November, 2018	₹. 64,600/-
December, 2018	₹.1,42,411/-
January 2019	₹. 64,600/-
Eebruary 2019	₹ 93,750/-
March 2019	₹1,57,430/-
TOTAL	₹ 5,22,791/-
TOTAL	

Grant received in each year: 7.

- : ₹. 30,51,000/- (Rupees thirty lakh fifty one thousand only) 1st Year a.
- 2nd Year: :NA b.
- :NA 3rd Year: c.
- Interest, if any : ₹. 29,092/- (Rupees Twenty nine thousand ninety two only) d.
- Total (a+b+c+d):₹. 30,80,092/- (Rupees Thirty lakh eighty thousand ninety two e. only)

(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (from 01-04-2018 to 31.03.2019)

		Total		Expenditu	re Incur	red	Total	Balance as		
SI. No (I)	Sanctioned Heads (II)	Funds Allocated (indicate sanctioned or revised) Rs. (III)	Funds received in 1 st year (IV)	1st year (01.10.2018 to 31.03.2019) (V)	2 nd Year (VI)	3rd year (VII)	Expenditure till 31.03.2019 (VIII = V + VI + VII)	on (31 st March 2019) (IX = IV – VIII)	Requirement of Funds upto 31 st March 2020 (in Rupees)	Remarks (if any)
1.	Manpower costs			₹3,87,600/-			₹3,87,600/-		₹8,05,200/-	Balance of ₹. 25.28.209/- has
2.	Consumables	₹27,55,200/-	₹9,05,200/-					₹4.76.159/-		been carried forward to next
3.	Travel			₹28,230/-			₹28,230/-	(4,70,13)/-	₹50,000/-	financial year
4.	Contingencies			₹13,211/-			₹13,211/-		₹50,000/-	(2019-20)
5.	Others (Arrear amount as a result of fellowship hike (1 st Jan., 2019 to 31 st March 2020)			-					#₹2,80,500	*₹29,092/- has been returned to bharatkosh.
6.	Equipment	₹19,95,800/-	₹19,95,800/-					**₹19,95,800/ -		** ₹19,95,800/- has been
7.	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-			₹93,750/-	₹56,250/-	₹1,50,000/-	committed for
8.	Interest on Bank (P-III)			*₹29,092/-						#Arrear statement
9.	Total	₹52,01,000/-	₹30,51,00/-	₹5,22,791-			₹5,22,791/-	₹25,28,209/-	₹13,35,700/-	is given separately

RDeka (R. C. Deka)

Name and Signature of Principal Investigator:

Date: 02/07/2020

* DOS - Date of Start of project

Note:

- 1. Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of DST i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)
- 2. Utilisation Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year

1.20 Signature of Competent financial authority: Date: Finance Officient seal) Tespur University

REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT OF EXPENDITURE (April 2019- March 2020)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	: ₹. 52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

6. Statement of Expenditure: (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred
April, 2019	₹ 64,600/-
May, 2019	₹. 64,600/-
June, 2019	₹. 64,600/-
July, 2019	₹. 64,600/-
August, 2019	₹. 64,600/-
September, 2019	₹. 21,93,571/-
October, 2019	₹. 0.00/-
November, 2019	₹ 0.00/-
December, 2019	₹ 0.00/-
January, 2020	₹ 12,928/-
February, 2020	₹ 0.00/-
March, 2020	₹. 0.00/-
Total Amount	₹ 25,29,499/-

7. Grant received in each year:

a. 1st Year : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only)

b. 2nd Year : NA

c. 3rd Year: : NA

- d. Interest, if any : ₹29,092/- (Rupees Twenty nine thousand ninety two only)
- e. Total (a+b+c+d) : ₹ 30,80,092/- (Rupees Thirty lakh eighty thousand ninety two only)

1

(to be submitted financial year wise ie. DOS* to 1st October of that financial year (01-04-2019 till 31.03.2020)

SI. No		Total Funds allocated	Total Funds allocated Funds		Expenditure Incurred			Balance as	Requirement	Remarks
(I)	Sanctioned Heads (II)	(Indicate sanctioned or revised) Rs. (III)	received in 1 st year (IV)	1 st year (1.10.2018 to 31.03.2019) (V)	2 nd year (1.04.2019 to 31.03.2020) (VI)	3 rd year (VII)	Expenditure Till 31.03.2020 (VIII=V+VI+ VII)	on 31 st March 2020 (IX=IV- VIII)	of Funds from 01.04.2020 to 31.03.2021 (in Rupees)	(if any)
1	Manpower costs			₹3,87,600/-	₹3,87,600/-		₹7,75,200/-		₹ 8,44,800	*₹29,092
2	Consumables							₹66.358/-		Interest of bank returned to
3	Travel	₹27,55,200/-	₹9,05,200/-	₹28,230/-	₹22,201/-		₹50,431/-		₹50,000/-	Bharatkosh
4	Contingencies			₹13,211/-			₹13,211/-		₹50,000/-	** -₹1,290/- has
5	Others (Arrear amount as a result of fellowship hike (1 st April 2020 to 30 th Sept., 2021)			Ŧ			4		*₹3,49,800	been adjusted from the overhead expenses
6	Equipment	₹19,95,800/-	₹19,95,800/-		₹20,33,425/-		₹20,33,425/-	-₹37,625/-		# 4 =======
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-		₹1,80,023/-	-₹30,023/-	₹1,50,000/-	statement is
8	Interest on bank			*₹29,092/-	Nil					given
9	Total	₹52,01,000/-	₹30,51,000/-	₹5,22,791/-	₹25,29,499/-		₹30,52,290/-	**-₹1,290/-	₹14,44,600	separatery

Deka (R. C. Deka) Name and Signature of Principal Investigator:

Date: 02/07/2020

14.8.20 Signature of Competent financial authority: (With seal) Finance Officer Tespur University Date:

* DOS - Date of Start of project

Note:

^{1.} Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)

^{2.} Utilization Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year.

<u>REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT</u> <u>OF EXPENDITURE (1st April 2020- 31st March 2021)</u>

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	:₹52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

6. Statement of Expenditure: (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred
April, 2020	₹ 0.00/-
May, 2020	₹ 0.00/-
June, 2020	₹ 0.00/-
July, 2020	₹ 0.00/-
August, 2020	₹ 0.00/-
September, 2020	₹ 0.00/-
October, 2020	₹ 4,75,200/-
November, 2020	₹ 3,00,000/-
December, 2020	₹2,21,000/-
January, 2021	₹ 0.00/-
February, 2021	₹ 0.00/-
March, 2021	₹ 0.00/-
Total Amount	₹ 9,96,200/-

7. Grant received in each year:

b.

- a. 1^{st} Year : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only)
 - 2^{nd} Year : ₹ 10,00,000/- (Rupees ten lakh only)
- c. 3rd Year: : NA
- d. Interest, if any : Nil
- e. Total (a+b+c+d) : ₹ 40,51,000/- (Rupees forty lakh fifty one thousand only)

1

(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (01-04-2020 till 31.03.2021)

SI. No		Total Funds allocated	Funds	Exp	oenditure Incu	red	Total	Balance	Requirement	Remarks
(1)	Sanctioned Heads (II)	(Indicate sanctioned or revised) Rs. (III)	received (IV)	01.10.2018 to 31.03.2019 (V)	01.04.2019 to 31.03.2020 (VI)	01.04.2020 to 31.03.2021 (VII)	Expenditure Till 31.03.2021 (VIII=V+VI +VII)	as on 31 st March 2021 (IX=IV- VIII)	of Funds from 01.10.2020 to 30.09.2021 (in Rupees)	(II any)
1	Manpower costs			₹3,87,600/-	₹3,87,600/-	₹9,96,200/-	₹17,71,400/-		₹8,44,800	*₹29,092
2	Consumables							₹70,158/-		Interest of bank
3	Travel	₹27,55,200/-	₹19,05,200/-	₹28,230/-	₹22,201/-		₹50,431/-		₹99,569/-	returned to
4	Contingencies			₹13,211/-			₹13,211/-		₹1,36,789/-	Bnaratkosh
5	Others (Arrear amount as a result of fellowship hike (1 st Feb. 2020 to 30 th Sept., 2021)								**₹3,52,000/-	**Arrear statement is given
6	Equipment	₹19,95,800/-	₹19,95,800/-		₹20,33,425/-		₹20,33,425/-	-₹37,625/-		separately
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-		₹1,80,023/-	-₹30,023/-	₹2,69,977/-	
8	Interest on bank			*₹29,092/-	Nil					
9	Total	₹52,01,000/-	₹40,51,000/-	₹5,22,791/-	₹25,29,499/-	₹9,96,200/-	₹40,48,490/-	₹2,510/-	₹17,03,135/-	

Rolaka (R.C. DEKA)

Name and Signature of Principal Investigator:

Date: 914/2021

Signature of Competent financial authority: (With seal) Findace Othicer Date:

Tespur University

* DOS - Date of Start of project

Note:

- 1. Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)
- 2. Utilization Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year.

<u>REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT</u> OF EXPENDITURE (1st April 2021- 31st March 2022)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	:₹52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

Statement of Expenditure: 6. (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred	
April, 2021	₹2510/-	
May, 2021	₹ 0.00/-	
June, 2021	₹ 0.00/-	
July, 2021	₹ 0.00/-	
August, 2021	₹ 0.00/-	
September, 2021	₹ 0.00/-	
October, 2021	₹ 0.00/-	
November, 2021	₹ 0.00/-	
December, 2021	₹4,05600/-	
January, 2022	₹34000/-	
February, 2022	₹ 7890/-	
Total Amount	₹ 4,50,000/-	

7. Grant received in each year:

- 1st Year 2nd Year 3rd Year: : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only) a.
- : ₹ 10,00,000/- (Rupees ten lakh only) b.
- :₹4,50,000/c.
- Interest, if any : Nil d.
- Total (a+b+c+d) : ₹ 45,01,000/- (Rupees forty lakh fifty one thousand e. only)

(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (01-04-2021 till 31.03.2022)

SL No		Total Funds allocated	Funds		Expenditur	e Incurred		Total	Balance as	Requirement	Remarks
(1)	Sanctioned Heads (II)	(II) sanctioned or revised) (II) Rs. (IV) (III)	01.10.2018 to 31.03.2019 (V)	01.04.2019 to 31.03.2020 (VI)	01.04.2020 to 31.03.2021 (VII)	01.04.2021 to 31.03.2022 (VIII)	Expenditur e Till 28.02.2022 (IX=V+VI+ VII+ VIII)	on 31 st March 2022 (X=IV-IX)	of Funds up to 31 st .03.2022 (in Rupees)	(if any)	
1	Manpower costs			₹3,87,600/-	₹3,87,600/-	₹9,96,200/-	₹4,39,600/-	₹22,11,000/-		₹4,05,600	
2	Consumables										
3	Travel	₹27,55,200/-	₹23,55,200/-	₹28,230/-	₹22,201/-		₹2,510/-	₹52,941/-	₹70,158/- ₹97,059/- stat/	**Arrear statement	
4	Contingencies			₹13,211/-			₹7,890/-	₹21,101/-		₹1.36.789/-	is given
5	Others (Arrear amount as a result of fellowship hike (1 st March. 2020 to 30 th Sept., 2021)									**₹3,35,000/-	separately
6	Equipment	₹19,95,800/~	₹19,95,800/-		₹20,33,425/-			₹20,33,425/-	-₹37,625/-		
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-			₹1,80,023/-	-₹30,023/-	₹2.69.977/-	
8	Interest on bank		1000 - 20 1000 - 20	₹29,092/-	Nil	₹63	Nil		₹63		
9	Total	₹52,01,000/-	₹45,01,000/-	₹5,22,791/-	₹25,29,499/-	₹9,96,200/-	₹4,50,000/-	₹44,98,490/-	₹2573/-	₹12,44,425/-	

Name and Signature of Principal Investigator:

* DOS - Date of Start of project

1

Date: 7/4/2022

Prof. Ramesh Ch. Deka Department of Chemical Sciences School of Science and Technology Tezpur University Napaam- 784028 : Tezpur : Assam

Signature of Competent financial authority (With seal) [Finance Officer Date: Tespur University

Note:

Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III) Utilization Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the 1.

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2. next financial year.

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Annexure-II

REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT OF EXPENDITURE (April 2018 - March 2019)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated: 20.08.2018
2.	Name of the PI	: Prof. Ramesh Ch. Deka
3.	Total Project Cost	:₹. 52,01,000/-
4.	Revised Project Cost	: N/A
5	(If applicable) Date of Commencement	: 01.10.2018

Statement of Expenditure: 6.

(Month wise expenditure incurred during the current financial year)

Month & Year	Expenditure incurred
April 2018	₹. 0.00/-
May. 2018	₹. 0.00/-
June, 2018	₹. 0.00/-
July, 2018	₹. 0.00/-
August, 2018	₹. 0.00/-
September, 2018	₹. 0.00/-
October, 2018	₹. 0.00/-
November, 2018	₹. 64,600/-
December, 2018	₹.1,42,411/-
January 2019	₹. 64,600/-
Eebruary 2019	₹ 93,750/-
March 2019	₹1,57,430/-
TOTAL	₹ 5,22,791/-
TOTAL	

Grant received in each year: 7.

- : ₹. 30,51,000/- (Rupees thirty lakh fifty one thousand only) 1st Year a.
- 2nd Year: :NA b.
- :NA 3rd Year: c.
- Interest, if any : ₹. 29,092/- (Rupees Twenty nine thousand ninety two only) d.
- Total (a+b+c+d):₹. 30,80,092/- (Rupees Thirty lakh eighty thousand ninety two e. only)

(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (from 01-04-2018 to 31.03.2019)

		Total		Expenditu	re Incur	red	Total	Balance as		
SI. No (I)	Sanctioned Heads (II)	Funds Allocated (indicate sanctioned or revised) Rs. (III)	Funds received in 1 st year (IV)	1st year (01.10.2018 to 31.03.2019) (V)	2 nd Year (VI)	3rd year (VII)	Expenditure till 31.03.2019 (VIII = V + VI + VII)	on (31 st March 2019) (IX = IV – VIII)	Requirement of Funds upto 31 st March 2020 (in Rupees)	Remarks (if any)
1.	Manpower costs			₹3,87,600/-			₹3,87,600/-		₹8,05,200/-	Balance of ₹. 25.28.209/- has
2.	Consumables	₹27,55,200/-	₹9,05,200/-					₹4.76.159/-		been carried forward to next
3.	Travel			₹28,230/-			₹28,230/-	(4,70,13)/-	₹50,000/-	financial year
4.	Contingencies			₹13,211/-			₹13,211/-		₹50,000/-	(2019-20)
5.	Others (Arrear amount as a result of fellowship hike (1 st Jan., 2019 to 31 st March 2020)			-					#₹2,80,500	*₹29,092/- has been returned to bharatkosh.
6.	Equipment	₹19,95,800/-	₹19,95,800/-					**₹19,95,800/ -		** ₹19,95,800/- has been
7.	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-			₹93,750/-	₹56,250/-	₹1,50,000/-	committed for
8.	Interest on Bank (P-III)			*₹29,092/-						#Arrear statement
9.	Total	₹52,01,000/-	₹30,51,00/-	₹5,22,791-			₹5,22,791/-	₹25,28,209/-	₹13,35,700/-	is given separately

RDeka (R. C. Deka)

Name and Signature of Principal Investigator:

Date: 02/07/2020

* DOS - Date of Start of project

Note:

- 1. Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of DST i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)
- 2. Utilisation Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year

1.20 Signature of Competent financial authority: Date: Finance Officient seal) Tespur University

REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT OF EXPENDITURE (April 2019- March 2020)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	: ₹. 52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

6. Statement of Expenditure: (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred
April, 2019	₹ 64,600/-
May, 2019	₹. 64,600/-
June, 2019	₹. 64,600/-
July, 2019	₹. 64,600/-
August, 2019	₹. 64,600/-
September, 2019	₹. 21,93,571/-
October, 2019	₹. 0.00/-
November, 2019	₹ 0.00/-
December, 2019	₹ 0.00/-
January, 2020	₹ 12,928/-
February, 2020	₹ 0.00/-
March, 2020	₹. 0.00/-
Total Amount	₹ 25,29,499/-

7. Grant received in each year:

a. 1st Year : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only)

b. 2nd Year : NA

c. 3rd Year: : NA

- d. Interest, if any : ₹29,092/- (Rupees Twenty nine thousand ninety two only)
- e. Total (a+b+c+d) : ₹ 30,80,092/- (Rupees Thirty lakh eighty thousand ninety two only)

1

(to be submitted financial year wise ie. DOS* to 1st October of that financial year (01-04-2019 till 31.03.2020)

SI. No		Total Funds allocated	Funds	Expen	diture Incurred	1	Total	Balance as	Requirement	Remarks
(I)	Sanctioned Heads (II)	(Indicate sanctioned or revised) Rs. (III)	received in 1 st year (IV)	1 st year (1.10.2018 to 31.03.2019) (V)	2 nd year (1.04.2019 to 31.03.2020) (VI)	3 rd year (VII)	Expenditure Till 31.03.2020 (VIII=V+VI+ VII)	on 31 st March 2020 (IX=IV- VIII)	of Funds from 01.04.2020 to 31.03.2021 (in Rupees)	(if any)
1	Manpower costs			₹3,87,600/-	₹3,87,600/-		₹7,75,200/-		₹ 8,44,800	*₹29,092
2	Consumables							₹66.358/-		Interest of bank returned to
3	Travel	₹27,55,200/-	₹9,05,200/-	₹28,230/-	₹22,201/-		₹50,431/-		₹50,000/-	Bharatkosh
4	Contingencies			₹13,211/-			₹13,211/-		₹50,000/-	** -₹1,290/- has
5	Others (Arrear amount as a result of fellowship hike (1 st April 2020 to 30 th Sept., 2021)			Ŧ			4		*₹3,49,800	been adjusted from the overhead expenses
6	Equipment	₹19,95,800/-	₹19,95,800/-		₹20,33,425/-		₹20,33,425/-	-₹37,625/-		# 4 =======
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-		₹1,80,023/-	-₹30,023/-	₹1,50,000/-	statement is
8	Interest on bank			*₹29,092/-	Nil					given
9	Total	₹52,01,000/-	₹30,51,000/-	₹5,22,791/-	₹25,29,499/-		₹30,52,290/-	**-₹1,290/-	₹14,44,600	separatery

Deka (R. C. Deka) Name and Signature of Principal Investigator:

Date: 02/07/2020

14.8.20 Signature of Competent financial authority: (With seal) Finance Officer Tespur University Date:

* DOS - Date of Start of project

Note:

^{1.} Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)

^{2.} Utilization Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year.

<u>REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT</u> <u>OF EXPENDITURE (1st April 2020- 31st March 2021)</u>

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	:₹52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

6. Statement of Expenditure: (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred
April, 2020	₹ 0.00/-
May, 2020	₹ 0.00/-
June, 2020	₹ 0.00/-
July, 2020	₹ 0.00/-
August, 2020	₹ 0.00/-
September, 2020	₹ 0.00/-
October, 2020	₹ 4,75,200/-
November, 2020	₹ 3,00,000/-
December, 2020	₹2,21,000/-
January, 2021	₹ 0.00/-
February, 2021	₹ 0.00/-
March, 2021	₹ 0.00/-
Total Amount	₹ 9,96,200/-

7. Grant received in each year:

b.

- a. 1^{st} Year : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only)
 - 2^{nd} Year : ₹ 10,00,000/- (Rupees ten lakh only)
- c. 3rd Year: : NA
- d. Interest, if any : Nil
- e. Total (a+b+c+d) : ₹ 40,51,000/- (Rupees forty lakh fifty one thousand only)

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(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (01-04-2020 till 31.03.2021)

Sl. No (I)	Sanctioned Heads (II)	Total Funds allocated (Indicate sanctioned or revised) Rs. (III)	Funds received (IV)	Expenditure Incurred			Total	Balance	Requirement	Remarks
				01.10.2018 to 31.03.2019 (V)	01.04.2019 to 31.03.2020 (VI)	01.04.2020 to 31.03.2021 (VII)	Expenditure Till 31.03.2021 (VIII=V+VI +VII)	as on 31 st March 2021 (IX=IV- VIII)	of Funds from 01.10.2020 to 30.09.2021 (in Rupees)	(if any)
1	Manpower costs	₹27,55,200/-		₹3,87,600/-	₹3,87,600/-	₹9,96,200/-	₹17,71,400/-	₹70,158/-	₹8,44,800	*₹29,092 Interest of bank returned to Bharatkosh
2	Consumables									
3	Travel		200/- ₹19,05,200/-	₹28,230/-	₹22,201/-		₹50,431/-		₹99,569/-	
4	Contingencies			₹13,211/-			₹13,211/-		₹1,36,789/-	
5	Others (Arrear amount as a result of fellowship hike (1 st Feb. 2020 to 30 th Sept., 2021)								**₹3,52,000/-	**Arrear statement is given
6	Equipment	₹19,95,800/-	₹19,95,800/-		₹20,33,425/-		₹20,33,425/-	-₹37,625/-		separately
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-		₹1,80,023/-	-₹30,023/-	₹2,69,977/-	
8	Interest on bank			*₹29,092/-	Nil					
9	Total	₹52,01,000/-	₹40,51,000/-	₹5,22,791/-	₹25,29,499/-	₹9,96,200/-	₹40,48,490/-	₹2,510/-	₹17,03,135/-	

Rolaka (R.C. DEKA)

Name and Signature of Principal Investigator:

Date: 914/2021

Signature of Competent financial authority: (With seal) Findace Othicer Date:

Tespur University

* DOS - Date of Start of project

Note:

- 1. Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III)
- 2. Utilization Certificate (Annexure III) for each financial year ending 31st March has to be enclosed along with request for carry-forward permission to the next financial year.

<u>REQUEST FOR ANNUAL INSTALMENT WITH UP-TO-DATE STATEMENT</u> OF EXPENDITURE (1st April 2021- 31st March 2022)

1.	DST sanction Order No and date	: SR/NM/NS-1147/2016(G) Dated:20.08.2018
2.	Name of the PI	: Ramesh Ch. Deka
3.	Total Project Cost	:₹52,01,000/-
4.	Revised Project Cost (If applicable)	: N/A
5.	Date of Commencement	: 01.10.2018

Statement of Expenditure: 6. (Month wise expenditure incurred during the current financial year)

Month & year	Expenditure incurred				
April, 2021	₹ 2510/-				
May, 2021	₹ 0.00/-				
June, 2021	₹ 0.00/-				
July, 2021	₹ 0.00/-				
August, 2021	₹ 0.00/-				
September, 2021	₹ 0.00/-				
October, 2021	₹ 0.00/-				
November, 2021	₹ 0.00/-				
December, 2021	₹4,05600/-				
January, 2022	₹34000/-				
February, 2022	₹ 7890/-				
Total Amount	₹ 4,50,000/-				

7. Grant received in each year:

- 1st Year 2nd Year 3rd Year: : ₹ 30, 51,000/- (Rupees thirty lakh fifty one thousand only) a.
- : ₹ 10,00,000/- (Rupees ten lakh only) b.
- :₹4,50,000/c.
- Interest, if any : Nil d.
- Total (a+b+c+d) : ₹ 45,01,000/- (Rupees forty lakh fifty one thousand e. only)

(to be submitted financial year wise i.e. DOS* to 1st October of that financial year (01-04-2021 till 31.03.2022)

SL No (I)	Sanctioned Heads (II)	Total Funds allocated (Indicate sanctioned or revised) Rs. (III)	Funds received (IV)	Expenditure Incurred				Total	Balance as	Requirement	Remarks		
				01.10.2018 to 31.03.2019 (V)	01.04.2019 to 31.03.2020 (VI)	01.04.2020 to 31.03.2021 (VII)	01.04.2021 to 31.03,2022 (VIII)	Expenditur e Till 28.02.2022 (IX=V+VI+ VII+ VIII)	on 31 st March 2022 (X=IV-IX)	of Funds up to 31 st .03.2022 (in Rupees)	(if any)		
1	Manpower costs	₹27,55,200/-			₹3,87,600/-	₹3,87,600/-	₹9,96,200/-	₹4,39,600/-	₹22,11,000/-		₹4,05,600		
2	Consumables												
3	Travel		₹23,55,200/-	₹28,230/-	₹22,201/-		₹2,510/-	₹52,941/-	₹70,158/-	₹97,059/-	Arrear statement		
4	Contingencies						₹13,211/-			₹7,890/-	₹21,101/-	1	₹1,36,789/-
5	Others (Arrear amount as a result of fellowship hike (1 st March. 2020 to 30 th Sept., 2021)									**₹3,35,000/-	separatery		
6	Equipment	₹19,95,800/~	₹19,95,800/-		₹20,33,425/-			₹20,33,425/-	-₹37,625/-				
7	Overhead expenses	₹4,50,000/-	₹1,50,000/-	₹93,750/-	₹86,273/-			₹1,80,023/-	-₹30,023/-	₹2,69,977/-	-		
8	Interest on bank			₹29,092/-	Nil	₹63	Nil		₹63				
9	Total	₹52,01,000/-	₹45,01,000/-	₹5,22,791/-	₹25,29,499/-	₹9,96,200/-	₹4,50,000/-	₹44,98,490/-	₹2573/-	₹12,44,425/-			

Name and Signature of Principal Investigator:

* DOS - Date of Start of project

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Date: 7/4/2022

Prof. Ramesh Ch. Deka Department of Chemical Sciences School of Science and Technology Tezpur University Napaam- 784028 : Tezpur : Assam

Signature of Competent financial authority (With seal) [Finance Officer Date: Tespur University

Note:

Expenditure under the sanctioned heads, at any point of time, should not exceed funds allocated under that head, without prior approval of SERB i.e. Figures in Column (VIII) should not exceed corresponding figures in Column (III) Utilization Certificate (Annexure III) for each financial year ending 31^{st} March has to be enclosed along with request for carry-forward permission to the 1.

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2. next financial year.

2