Progress Report

CRS proposal Number: CRS/2021-22/01/354

Name of the PI: Dr. Shyamal Kumar Das

PI's Institute: Tezpur University, Assam

Title of the Proposal: Unravelling the trivalent ion electrochemistry of niobium and bismuth-based chalcogenides and understanding the electrochemical mechanism by X-ray photoelectron spectroscopy for aluminum-based energy storage devices

Name of the Principal Collaborator (PC): Dr. S. R. Barman

Name of Centre at which the PC is associated: Indore

Objectives as stated in the approved proposal: (i) Develop simple and cost-effective strategies to obtain highly porous current collectors for batteries and ultracapacitors in order to achieve high mass loading of electrode materials, (ii) In-situ electrochemical deposition of niobium (Nb) and bismuth (Bi) based chalcogenides on the porous current collectors, (iii) Structural analysis of the integrated electrodes and determine the structure property correlation using XRD, XPS, HRTEM, Raman Spectroscopy etc., (iv) Evaluate the Al^{3+} ion electrochemistry of Nb and Bi based chalcogenides utilizing galvanostatic technique, cyclic voltammetry, impedance spectroscopy, GITT measurements etc., (v) Understand the fundamental electrochemical mechanism of Al^{3+} ion insertion utilizing X-ray photoelectron spectroscopy

Summary of the work done (within 250 words) and details of journal publications including the names of all authors:

The project initially concentrated on the identification of the substrate and it was found that carbonaceous materials are better suited for aluminum-ion batteries. Building on it, we investigated the electrochemistry of Bi_2MoO_6 and Bi_2WO_6 for Al^{3+} ion storage in aqueous electrolyte. It was found that the electrochemical characteristics are quite dependent on the nature of the current collector and the electrolyte. With the optimization of the current collectors and electrolytes, the potential of Bi_2MoO_6 and Bi_2WO_6 for aluminum-ion battery is illustrated. Later on, a systematic study was undertaken to understand the electrochemical activities of bismuth niobate ($Bi_5Nb_3O_{15}$). We exclusively show here the dependence of corrosion rate and diffusion of charged species on the electrochemical performance of $Bi_5Nb_3O_{15}$. In addition, the influence of hydrogen doping on the electrode material for aluminum-ion battery was also demonstrated. It was found that hydrogen doping significantly enhanced the high rate performance of aluminum-ion battery. An excellent high-rate performance is observed with specific capacity exceeding 100 mAh/g at a very high current rate of 20 A/g. It was revealed that the drastic reduction in the charge transfer resistance at the electrode-electrolyte interface is the reason for the enhancement.

The following publications are the outcome of the work completed so far.

(i) R. Baishya, H. Phukon, D. Kalita, S. R. Barman, S. K. Das, *Journal of Energy Storage* 94 (2024) 112541.

(iii) R. Baishya, K. Roy and S. K. Das, *Chem. Commun.* 2025, https://doi.org/10.1039/D5CC00784D

(ii) R. Baishya and S. K. Das, *ChemNanoMat* 2025 (under review)

Details of the visits to UGC-DAE CSR:

Name of the visitor (student/PI)	Facilities used	Date and duration
NA	NA	NA

Difficulties in availing the facilities of UGC-DAE CSR: No

Statement of accounts:

Fund received (TOTAL)		Expenditure made as on 31.03.2025		Available balance	
Contingency	Fellowship	Contingency	Fellowship	Contingency	Fellowship
45,000	549,360	45,000	4,60,193	Nil	89,167

(Attach an updated statement of accounts from the Registrar or Finance Officer of your institute for the next release of grants)

Signature of the PI

Gmail

Shyamal Kumar Das <skdstring@gmail.com>

CRS Projects (2021-22) Closure of Projects Sanctioned during 2021–22 and Submission of Final Documents-reg.

1 message

UGC-DAE CSR <info@csruserportal.com> Thu, Apr 30, 2026 at 2:21 PM
Reply-To: info@csruserportal.com
To: skdstring@gmail.com

विश्वविद्यालय अनुदान आयोग - परमाणु ऊर्जा विभाग वैज्ञानिक अनुसंधान संकुल
UGC-DAE Consortium for Scientific Research
(An Autonomous Institution of University Grants Commission, New Delhi)

CRS Program

CRS Projects 2021-22.

Dear **Shyamal Kumar Das**,

It is hereby informed that your CRS project (**CRS/2021-22/01/354**) in pursuance of the decision taken by the Competent Authority to streamline administrative processes, all projects sanctioned during the year **2021–22** stand closed with immediate effect. Accordingly, no further extension or additional financial assistance shall be provided for the aforesaid projects. It may also be noted that this closure is purely on administrative grounds, and interested investigators may apply afresh in response to future calls for proposals, as and when notified. All concerned PIs are hereby requested to upload the following documents immediately on the user portal:

Final Progress Report (FPR)

Utilization Certificate (UC) for the sanctioned grant

Unspent balance may please be refunded to the Institute account under intimation to this Centre. The details of the Institute account are as under:

A/c Name- UGC DAE CSR PLAN
A/c No: 63001094343
Bank & Branch- State Bank of India, DAVV Bhawarkua, Indore
IFSC- SBIN0030389

Best regards,

For any query please write to:
Mr. Narian Kumar Lengay
Administrative Officer-I
narianl@csr.res.in

UGC-DAE Consortium for Scientific Research, Indore

Please do not reply,This is system generated email.

Annexure-III

UTILISATION CERTIFICATE
FOR THE FINANCIAL YEAR 2024-25

1	Title of the Project/Scheme :		**Unravelling the trivalent ion electrochemistry of niobium and bismuth based chalcogenides and understanding the electrochemical mechanism by X-ray photoelectron spectroscopy for aluminum based energy storage devices/CRS**
2	Name of the Institution		**Tezpur University, Assam**
3	Principal Investigator		**Dr. Shyamal Kumar Das**
4	UGC-DAE Consortium for Scientific Research sanction order No & date sanctioning the project		**Ref: CRS/2021-22/01/354 and dated 30.03.2022**
5	Head of account as given in the original sanction order		**The Registrar**
6	Amount brought forward from the previous financial year quoting UGC-DAE Consortium for Scientific Research letter no & date in which th authority to carry forward the said amount was given	i. Amount (Rs.)	**289,110.00**
		ii. Letter No.	**NA**
		iii. Date	**NA**
7	Amount received during the financial year (2024-25)	i. Amount (Rs.)	**169,625.00**
		ii. Letter/Order No	CRS/2021-22/01/354
		iii. Date	**5/3/2024**
8	Total amount that was available for expenditure (excluding commitments) during the financial year (Sl No 6+7)	**Rs.**	**458,735.00**
9	Actual expenditure (Excluding commitments)	**Rs.**	**351,137.00**
10	Balance amount available at the end of the financial year	**Rs.**	**107,598.00**
11	Unspent balance refunded, if any	**Rs.**	**NIL**
12	Amount to be carried forward to the next financial year or to be returned	**Rs.**	**107,598.00**

07.04.2025

(Principal Investigator)

Finance Officer
Finance Officer
Tezpur University

07/04/2025

Signature of the Head of the Institute
Registrar
Tezpur University

UTILISATION CERTIFICATE

Certified That out of Rs.1,69,625.00 of grants-in-aid sanctioned during the year 2024-2025 in favour of The Registrar (Through Dr. Shyamal Kumar Das) under UGC-DAE Consotrium of Scientific Research letter/Order No. Ref: CRS/2021-22/01/354 dated 21.02.2025 and Rs.2,89,110.00 on account of unspent balance of the previous year, a sum of Rs. 3,51,137.00 has been utilised for the purpose of execution of the project for which it was sanctioned and that the balance of Rs.1,07,598.00 remainig unutilised at the end of the year has been surrendered to the UGC-DAE Consotrium of Scientific Research (Vide DD No Nil Dated Nil) will be adjusted towards the grants-in-aid payable during the next year i.e._____

(Principal Investigator)

Date : 07.04.2025

Finance Officer

Finance Officer

Date : Tezpur University

Signature of the Head of the Institute

Registrar

Tezpur University

Date :

(To be filled by UGC-DAE CSR)

Certified that I have satisfied that the conditions on which the grants-in-aid ws sanctioned have been fulfilled/are being fuilfilled and that I have excercised the following checks to see that the money was actually utililsed for the purpose for which it

Kinds of Checks exercised.

1
2
3
4
5

Signature :_____

Designation:_____

Date :_____

Statement of Expenditure
for the Financial Year 22-23, 23-24, 24-25.

Sl No	Sanctioned Heads	Total Funds Allocated (Sanctioned)	Expenditure Incurred			Total Expenditure till 31.03.2025	Balance as on 31.03.2025	Remarks (If any)
			1st Year (22-23)	*2nd Year (23-24)*	*3rd Year (24-25)*			
(I)	(II)	(III)	(IV)	(V)	(VI)	(VII=IV+V+VI)	(VIII=III-VII)	
	Student Fellowship	549,360.00	124,645.00	56,000.00	279,548.00	460,193.00	89,167.00	
	Consumables	90,000.00	29,980.00	NIL	41,589.00	71,569.00	18,431.00	
	Contingency	45,000.00	15,000.00	NIL	30,000.00	45,000.00	-	
						-	-	
						-	-	
						-	-	
						-	-	
8	**Total**	**684,360.00**	**169,625.00**	**56,000.00**	**351,137.00**	**576,762.00**	**107,598.00**	

(Principal Investigator)

Date : 07.04.2025

Finance Officer

Date : 21/4/25

Finance Officer
Tezpur University

Signature of the Head of the Institute

Date : 24/4/2025

Registrar
Tezpur University