Indian Institute of Technology Delhi

Department of Chemical Engineering

Ph.D. Viva Voce Exam Notification

Date: 12.06.2026

Dear all,

Mr. Guguloth Venkanna (2019CHZ8163) will present his Ph.D. Viva Voce Exam in hybrid mode on Friday, 19th June 2026, at 4:30 pm in the Department of Chemical Engineering Seminar Room, as well as on MS Teams. The title of the presentation is "**Solar Light-Driven Heterojunctions of 'Ti' and 'Cu' Oxide-Based Photocathode Electrodes to Reduce the CO_2 to Valuable Chemicals and Fuels**", for which the abstract is enclosed below. Kindly attend in-person or join ONLINE at the following link:

Microsoft Teams meeting link: Join:

https://teams.microsoft.com/l/meetup-join/19%3ameeting_NWY5NGQ1NzktNWJhMy00NWJmLTk4ZmItYzMzMTZkMGIzOWY3%40thread.v2/0?context=%7b%22Tid%22%3a%22624d5c4b-45c5-4122-8cd0-44f0f84e945d%22%2c%22Oid%22%3a%221f984b91-e192-467b-b500-7c533415f225%22%7d

Meeting ID: 418 760 623 822 64

Passcode: Rz7M5mU9

All are cordially invited to attend.

Regards,

Prof. K.K.Pant (Ph.D. Supervisor) & Prof. Anil Verma, IIT Delhi (Ph.D. Co-Supervisor)

Copy To:

1. Ph.D. Thesis External Examiner: Prof. Ch. Subramanyam, IIT Hyderabad

2. SRC Members: Prof. Anupam Shukla (Chairperson), Prof. Manojkumar C Ramteke (Departmental Expert), Prof. Neeraj Kahre, Department of Physics (External Expert)

3. HOD, Chemical Engineering Department

4. DRC Chairperson, Chemical Engineering Department

5. DRC Convenor, Chemical Engineering Department

6. Ph.D. Coordinator, Chemical Engineering Department

7. All Faculty & Students, Chemical Engineering Department

8. Dean (Academics), IIT Delhi

9. Dy. Registrar (Accounts). IIT Delhi

Encl: Thesis Abstract (1 page)

Abstract

Solar Light-Driven Heterojunctions of 'Ti' and 'Cu' Oxide-Based Photocathode Electrodes to Reduce the CO_2 to Valuable Chemicals and Fuels

Excessive use of fossil fuels to meet the energy demands of a prosperously and economically driven nation, combined with a growing human population, has led to high carbon dioxide (CO_2) emissions as a greenhouse gas, causing ecological imbalance. It is crucial to shift towards alternative renewable fuels, with particular emphasis on sustainably harnessing of solar energy for solar fuel production. Photoelectrochemical (PEC) CO_2 reduction stands out as a promising and viable strategy that enables storing abundant diurnal solar energy and reducing the highly stable CO_2 molecule. However, several key challenges, such as low light absorption, high charge recombination, photo corrosion, and the formation of undesired or lower-yield products, hinder progress in PEC development. Selecting and optimizing appropriate photoelectrodes are essential for improving selectivity and product yields. To address the several challenging issues in PEC CO_2 reduction. This thesis mainly focused on synthesizing various charge transfer mechanisms in photoelectrodes to boost higher product formation. Strategies included creating the Type-II heterojunction of Cu_xO-$SrTiO_3$ in the first objective, developing an indirect platinum (Pt) mediated Z-Scheme of TiO_2-Pt-Cu_2O heterojunction in the second objective, and the various defect concentration modification in TiO_2 Nanotubes (NT's) to form the direct Z-Scheme of TiO_2-Cu_2O heterojunctions in the third objective. These modifications to form the different charge transfer in heterojunctions have improved the optical, electronic, and photocatalytic activity properties, resulting in enhanced product formation. The highest methanol yield in liquid form as a main product was achieved with the TiO_2-Pt-Cu_2O (~117.6 $\mu mol.cm^{-2}.h^{-1}$) indirect Z-Scheme heterojunction photoelectrode, followed by the direct Z-Scheme Defective 0.5M TiO_2-Cu_2O (~76.5 $\mu mol.cm^{-2}.h^{-1}$) photoelectrode, and the Cu_xO-$SrTiO_3$ (~48.69 $\mu mol.cm^{-2}.h^{-1}$) heterojunction photoelectrode. By considering the advantages of a direct Z-Scheme charge transfer, which eliminates the need for an intermediate metal charge-transport layer, we further pursued the final objective of continuous PEC CO_2 reduction reactions using the optimized defective 0.5M TiO_2-Cu_2O photoelectrode. This continuous process has achieved a higher cumulative methanol production of approximately 231.42. $\mu mol.cm^{-2}$ after 5 hours at an electrolyte flow rate of 40 millilitres per hour (mL/h). Therefore, the strategic synthesis and parameter optimization understanding in the current study can pave the way for future directions in advancing solar fuel production via photoelectrochemistry.