The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	**RATIONAL DESIGN OF HIGHLY EFFICIENT SOLAR LIGHT DRIVEN PHOTOCATALYSTS FOR CO2 CONVERSION TO FUELS**
PROJECT CODE	**UQIDAR 00124**
PROJECT DESCRIPTION	The greenhouse effect and global warming are the most important issue facing the present day. A number of initiatives are trying to come up with a way to decrease emissions of greenhouse gases. CO2 is a major greenhouse gas which causes global environmental problems. Carbon dioxide's radiative forcing is around 1.74 W mâˆ'2, and it is estimated that CO2 is the largest contributor to global warming, accounting for 63% of total radiative forcing. Carbon dioxide is mainly produced from fossil fuels combustion, and it is estimated that more than 31 billion tons of CO2 is produced annually all over the world. The CO2 concentration in the atmosphere already crossed 400 ppm in most places and keeps increasing by approximately 2 ppm per year. The finite supply of fossil resources has driven research activities toward finding other carbon resources for the production of fuels and chemicals. The capture and Utilization of CO2 is highly desirable for mitigating air pollution and for replacing conventional fossil fuels because it is a cheap, nontoxic and abundant C1 feedstock. The major objective of the present proposal is the production of renewable, clean fuels using a highly efficient green photocatalytic route that uses visible light induced photocatalysts and carbon dioxide captured from industrial flue gas effluent. To this purpose several non-toxic, stable visible light induced new heterogeneous nanostructure modified photocatalysts will be prepared, characterized and screened in CO2 to fuels reaction. Some examples of the nanostructures are: ZnTiO3, Co3O4, Fe2O3 and ZnCdS with different co-catalysts such as NiS, Ti3C2, carbon dot and different non-precious metal/non-metal and nanocomposites coupled with other semi-conductor and carbon based materials like graphene, g-C3N4, CNT and MWCNT. Theoretical investigations using DFT calculations will be performed for the rational design of these. The process parameters optimization of the reactions will be performed and the kinetics studies will be undertaken. A suitable model for the photocatalytic reaction will be developed and validated with experiments.
PROJECT OUTCOMES	1) Development of photocatalysts for CO2 capture and conversion to give fuels by utilizing abundant solar light energy. 2) Development of a process for photocatalytic carbon dioxide capture and conversion to fuels using solar light energy. 3) Optimization of all the process parameters for carbon dioxide conversion to fuels for a range of hydrocarbons and a model equation will be developed which can be used for scale-up. 4) One joint PhD from IIT Delhi, India and Univ. of Queensland, Australia. 5) Student and cultural exchange between India and Australia. 1. 6) Successful collaborative research between IITD and Univ. of Queensland that will benefit both countries India and Australia.
ADVISORY TEAM	**Professor George Zhao** https://researchers.uq.edu.au/researcher/474 george.zhao@uq.edu.au School of Chemical Engineering The University of Queensland **Professor Upadhyayula Sreedevi** http://web.iitd.ac.in/~sreedevi/ sreedevi@chemical.iitd.ac.in

	Department of Chemical Engineering Indian Institute of Technology Delhi
TYPE OF STUDENT	Applications are open to i/a students who meet eligibility criteria.
DISCIPLINE BACKGROUND OF STUDENT	Ideally, this project requires students with a background in chemical engineering, chemistry, chemical technology, catalysis.
IDEAL CANDIDATE	Essential capabilities: • Good and consistent academic record • Interest in 60% experimental research work and 40% theoretical research work. Desirable capabilities: • MATLAB Coding, GAUSSIAN, MATERIAL STUDIO, VASP software packages Expected qualifications (courses, degrees, etc): • For Australian students: Honour's degree in Chemical Engineering, Chemistry, Material Science & Engineering with minimum GPA 5.65/7 which should include relevant research component. • For Indian students: Masters in Chemical Engineering/ Masters in Material Science & Engineering wit minimum GPA of 6.5/ B.Tech in Chemical Engineering with minimum GPA of 8.0 and (for non-CFTI) high GATE or NET or CSIR or DST/ Masters in Chemistry with minimum GPA of 6.5 and high GATE or NET or CSIR or DST.
APPLICATION PROCESS	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/