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### **Research Interests**

- **Catalysis and reaction engineering**
- **Supported metal and metal oxide catalysis** : synthesis, characterization and reactivity
- **Membrane separation**

### **Brief Overview**

Research in our group is resting on understanding the catalytic activity and selectivity issues for supported metal and metal oxide and related heterogeneous catalyzed systems. Our current research interest is in the broad area of heterogeneously catalyzed reactions involving hydrocarbons for which the effects of various catalyst parameters were studied. A judicious choice of characterization techniques complimented with reactivity data assists in the understanding why some of the parameters do or do not have an effect on the catalytic activity and selectivity. Designing a catalyst using modifiers has also been undertaken and from the structure-reactivity relationships and statistical methodologies, an optimum catalytic composition was determined. Specifically, the reactions that are under consideration: (i) Dry Reforming of Methane to produce syngas and (ii) CO<sub>2</sub> hydrogenation for the production of Methanol. Future studies will involve other hydrocarbon based reactions and the utilization of simultaneous *in situ* characterization and reaction techniques, coined as *Operando* spectroscopy, for the understanding of some heterogeneously catalyzed reactions.

## **Publications:**

- 1 *Ni/Ce<sub>x</sub>Zr<sub>1-x</sub>O<sub>2</sub> catalyst prepared via one-step co-precipitation for CO<sub>2</sub> reforming of CH<sub>4</sub> to produce syngas: Role of oxygen storage capacity (OSC) and oxygen vacancy formation energy (OVFE),* M Prasad, K Ray, A Sinhamahapatra, **S Sengupta**; Journal of Materials Science (accepted)
- 2 *Black TiO<sub>2-x</sub> Nanoparticles Decorated with Ni Nanoparticles and Trace Amounts of Pt Nanoparticles for Photocatalytic Hydrogen Generation,* S Biswas, H-Y Lee, M Prasad, A Sharma, J-S Yu, **S Sengupta**, D D Pathak, and A Sinhamahapatra; ACS Applied Nano Materials 2021, 4, 5, 4441-4451
- 3 *Catalytic CO<sub>2</sub> reforming of CH<sub>4</sub> over MgAl<sub>2</sub>O<sub>4</sub> supported Ni-Co catalysts for the syngas production,* R Kumari, S Sengupta; International Journal of Hydrogen Energy, 45(2020) 22775-22787.
- 4 *Reforming and cracking of CH<sub>4</sub> over Al<sub>2</sub>O<sub>3</sub> supported Ni, Ni-Fe and Ni-Co catalysts;* K Ray, **S Sengupta**, G Deo; Fuel Processing Technology, 156 (2017) 195-203.
- 5 *Modifying alumina with CaO or MgO in supported Ni and Ni-Co catalysts and its effect on dry reforming of CH<sub>4</sub>;* **S Sengupta** and G Deo, Journal of CO<sub>2</sub> Utilization, 10 (2015) 67-77.
- 6 *Corrosion Behavior of IF Steel in Various Media and Its Comparison with Mild Steel;* G P Singh, A P Moon, **S Sengupta**, G Deo, S Sangal and K Mondal, Journal of Materials Engineering and Performance, 24 (2015) 1961-1974.
- 7 *The effects of modifying the Ni/Al<sub>2</sub>O<sub>3</sub> catalyst with cobalt on the catalytic reforming of CH<sub>4</sub> with CO<sub>2</sub> and cracking of CH<sub>4</sub> reactions;* **S Sengupta**, K Ray and G Deo, International Journal of Hydrogen Energy, 39 (2014) 11462-11472.
- 8 *Effect of calcination temperature during the synthesis of Co/Al<sub>2</sub>O<sub>3</sub> catalyst used for the hydrogenation of CO<sub>2</sub>;* Taraknath Das, **S Sengupta** and G Deo, Reaction Kinetics, Mechanisms and Catalysis, 110(2013) 147-162.
- 9 *Effects of co-solutes on Cr(VI) removal by micellar enhanced ultrafiltration (MEUF) process;* A Choudhary, **S Sengupta**, C Bhattacharjee and S Datta, Desalination and Water Treatment, 44 (2012) 67-74.
- 10 *A study based on the different dosing levels of primary tannery wastewater treatment* S Mondal., S Dasgupta., **S Sengupta**, C Bhattacharjee; Indian Journal of Environmental Protection, 2010, 30(1), pp. 40–45.
- 11 *Extraction of Hexavalent Chromium from Aqueous Stream by Emulsion Liquid Membrane (ELM);* A Choudhary, **S Sengupta**, C Bhattacharjee and S Datta, Separation Science and Technology, 45 (2010) 178-185.

**No. of PhD guided:** 01 (2021)

**No. of PhD being guided at present** – 4 full time and 1 part time

**No. of M. Tech Projects supervision:**

Guided: 9 students (1 co-guide); 1 ongoing

**Paper in National & International Conferences:**

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- M Prasad, **S Sengupta**, Dry Reforming of Methane for the Production of Syngas over Ceria-Zirconia Supported Nickel-based Catalysts, ACES-2020 IISER Bhopal
- M Prasad, **S Sengupta**, Thermodynamic Analysis of Dry Reforming of Methane for the Production of Syngas using Aspen Plus at Equilibrium Conditions, CHEMCON-2020
- Goutam Deo, Koustuv Ray, Aditya S. Sandupatla, **S Sengupta**, Sudhir C. Nayak, Puneet K. Chaudhary and Neeraj Koshta; Good Catalyst Better Catalyst for the CO<sub>2</sub> Reforming of CH<sub>4</sub> : A Bit of Science and Engineering for this Catalytic Reaction, 26<sup>th</sup> meeting of the North American Catalysis Society (NAM26) 2019, Chicago, USA.
- R Kumari and **S Sengupta**, *Dry Reforming of Methane over Ni based Catalysts*, Conference on Advances in Catalysis for Energy and Environment (CACEE-2018), organized by TIFR, Mumbai, 2018.
- G Saha and **S Sengupta**, *Catalytic CO<sub>2</sub> Hydrogenation to Methanol Production*, Conference on Advances in Catalysis for Energy and Environment (CACEE-2018), organized by TIFR, Mumbai, 2018.
- **S Sengupta** and G Deo, *CO<sub>2</sub> reforming of CH<sub>4</sub> over modified Ni/Al<sub>2</sub>O<sub>3</sub> catalysts*, 12<sup>th</sup> International Conference on Carbon Dioxide Utilization (ICCDU XII), 2013 Alexandria, Virginia, United States.
- K Ray, **S Sengupta** and G Deo, *Catalytic activity of alumina supported Ni-based bimetallic catalysts*, 2<sup>nd</sup> International Conference on Materials for Energy ENMAT II, 2013, Karlsruhe, Germany.
- **S Sengupta** and G Deo, *CO<sub>2</sub> Reforming of CH<sub>4</sub> to Produce Syngas over Metal-Supported Catalysts*. 15<sup>th</sup> International Congress on Catalysis 2012, 2012, Munich, Germany.

- **S Sengupta** and G Deo, *CO<sub>2</sub> Reforming of CH<sub>4</sub> to Produce Syngas over Metal-Supported Catalysts*. 2<sup>nd</sup> Indo-German Workshop on “Advances in Reaction and Separation Processes, 2012, Bad Herrenalb, Germany.
- **S Sengupta** and G Deo, *CO<sub>2</sub> reforming of CH<sub>4</sub> to produce synthesis gas over modified and unmodified Ni/Al<sub>2</sub>O<sub>3</sub> catalysts*. ChEmference 2011, Chemical Engineering Department, IISc Bangalore, 2011, India.
- **S Sengupta** and G Deo, *CO<sub>2</sub> reforming of CH<sub>4</sub> to produce synthesis gas over modified and unmodified Ni/Al<sub>2</sub>O<sub>3</sub> catalysts*. 11<sup>th</sup> International Conference on Carbondioxide Utilization (ICCDU XI), 2011, Dijon, France.

**The details of research work and funding from external agencies are listed below:**

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Sl. No.	PI/Co-PI	Sponsoring Authority	Topic/ Field	Sanctioned Amount (Lakhs)	Status
01	Co-PI	CMPDI Ltd.	High Ash gasification and associated upstream and downstream processes (Coal to Chemicals- CTC)	2160.721	Ongoing
03	PI	DST (SERB)	Development of an efficient Pd-Cu bimetallic catalyst for the catalytic CO <sub>2</sub> hydrogenation for Methanol production	22.15	Completed
04	PI	TEQIP-II	TEQIP-II under Minor Research Project Scheme, ISM Dhanbad	1.5	Completed
05	PI	Faculty Research Scheme (FRS), ISM Dhanbad	CO <sub>2</sub> reforming of CH <sub>4</sub> over modified Ni based catalysts for synthesis gas production	11.15	Completed

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