



RCMS

Research Center for Materials Science



GTR-RCMS-IRCCS Seminar

**Toward Artificial Photosynthesis:
Photosensitizer-Free Molecular CO₂ Reduction**

Associate Prof. Arnab Dutta

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Thursday, May 14, 2026, 15:30–17:00

**Science South Building
NEOREX PLACE Seminar Room**



The development of selective, efficient molecular systems for CO₂ reduction is imperative for advancing carbon-neutral energy technologies. This presentation describes the development of bio-inspired molecular catalysts for selective CO₂-to-CO conversion, with an emphasis on integrating carbon management with light harvesting. Rationally designed Mn(I) catalysts were investigated to address key limitations of conventional systems, including dimer formation, high overpotential, poor selectivity, and photo-instability. Systematic ligand modification produced improved catalysts that show enhanced stability and efficient CO₂ reduction in both organic and aqueous media, including simulated flue gas conditions. Mechanistic studies using electrochemistry, spectro-IR, spectro-UV–vis, and bulk electrolysis identified the key catalytic intermediates and pathways. Building on these findings, a self-sensitized molecular platform was developed that enables photosensitizer-free photochemical CO₂-to-CO conversion with high selectivity and sustained activity under light irradiation. These results provide a unified molecular design strategy for advancing practical, light-driven CO₂ valorization and integration into artificial photosynthetic assemblies.

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