National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Harvesting Visible-Light Energy for the Synthesis of Spirocycles, O-containing Heterocycles Through the Functionalization of C-C Triple Bonds
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Supervisor	: Debayan Sarkar
Venue	: Chemistry Seminar Room
Date and Time	: 30 Jul 2025 (03.30 PM)
Abstract	: Visible-light photoredox catalysis has emerged as a transformative tool in organic synthesis, enabling mild and sustainable access to complex molecular architectures such as spirocycles and oxygen-containing heterocycles. Spirocyclic frameworks, notably spiro[5.5] and spiro[4.5] motifs, are prevalent in bioactive natural products and pharmaceuticals but remain synthetically challenging due to the need for atom- and step-economical routes. Similarly, oxygen heterocycles widely found in medicinal molecules and functional materials continue to drive innovation in photoredox-driven cyclizations. This thesis investigates novel visible-light-mediated methodologies that integrate radical-mediated dearomatization and cascade cyclization to construct spirocyclic and oxygenated heterocyclic scaffolds from simple biaryl and alkyne precursors. In addition to radical cascade addition to the alkyne, diverse nucleophiles such as -SCN, -$SP(O)(OEt)_2$ are installed via an arene radical cation intermediate. By leveraging single-electron transfer (SET) mechanisms and avoiding stoichiometric oxidants and metal-based catalysts, the work focuses on delivering high atom economy, functional-group tolerance, and sustainability. Sulphonated spirotrienones are synthesised in a multicomponent fashion, as an effective alternative to traditional reported methods. Fluorine containing spiro cycles are also synthesized under visible-light conditions using $BrCF_2CO_2Et$ as potent fluorine source. Except synthesis, mechanistic elucidation through control experiments and electrochemical analysis was done. Further functionalization of the synthesized compounds to other related novel scaffold and addition of drug like molecules addresses the growing demand in medicinal chemistry for sustainable synthetic strategies to access complex and bioactive molecular frameworks, paving new avenues for future drug and material discovery.