Expanding Chemical Space Through Selective Catalysis

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Cross-coupling reactions are limited by the need for prefunctionalized partners, instability, and cost, restricting access to diverse chemical space. To address this, we develop methods for direct C–H functionalization and cross-electrophile coupling (XEC). Remote C–H activation is challenging due to unfavorable transition states, which we overcome using covalently attached templates and non-covalent interactions to precisely position catalysts.[1,2] We also employ photochemistry and artificial metalloenzymes to achieve site-selective C–H activation under mild conditions.[3,6] Notably, we developed a palladium-catalyzed method for selective methylene C–H activation over methyl groups via carboxylic acid coordination.[4] For XEC, we established a visible-light-driven, ligand-controlled monometallic system to access unsymmetrical (hetero)biaryls.[5] Additionally, we explore visible-light photocatalysis for converting small molecules like CO_2 and SO_2 into value-added products.[7]

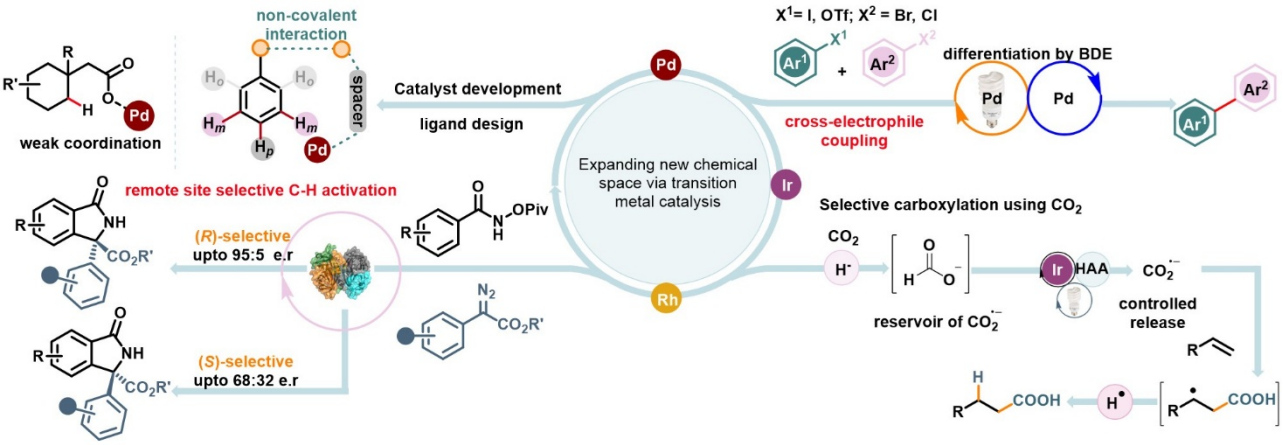

Fig 1: Innovative Transition Metal Catalysis for Sustainable Molecular Diversification

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