

Asymmetric Photoenzymatic Incorporation of Fluorinated Motifs into Olefins

Background/Objective

Enzymes for incorporating fluorinated motifs are scarce, limiting the biosynthesis of critical fluorinated compounds in agrochemicals. This study aimed to develop a photoenzymatic method using flavin-dependent ene-reductases to enantioselectively incorporate fluorinated motifs into olefins.

Approach

Using ene-reductase OYE1 or OYE3 with trifluoroiodoethane under blue light, the method generates carbon-centered radicals for enantioselective incorporation into olefins. Optimization was focused on mutagenesis, reaction conditions, and mechanistic studies combining molecular docking and deuterium labeling.

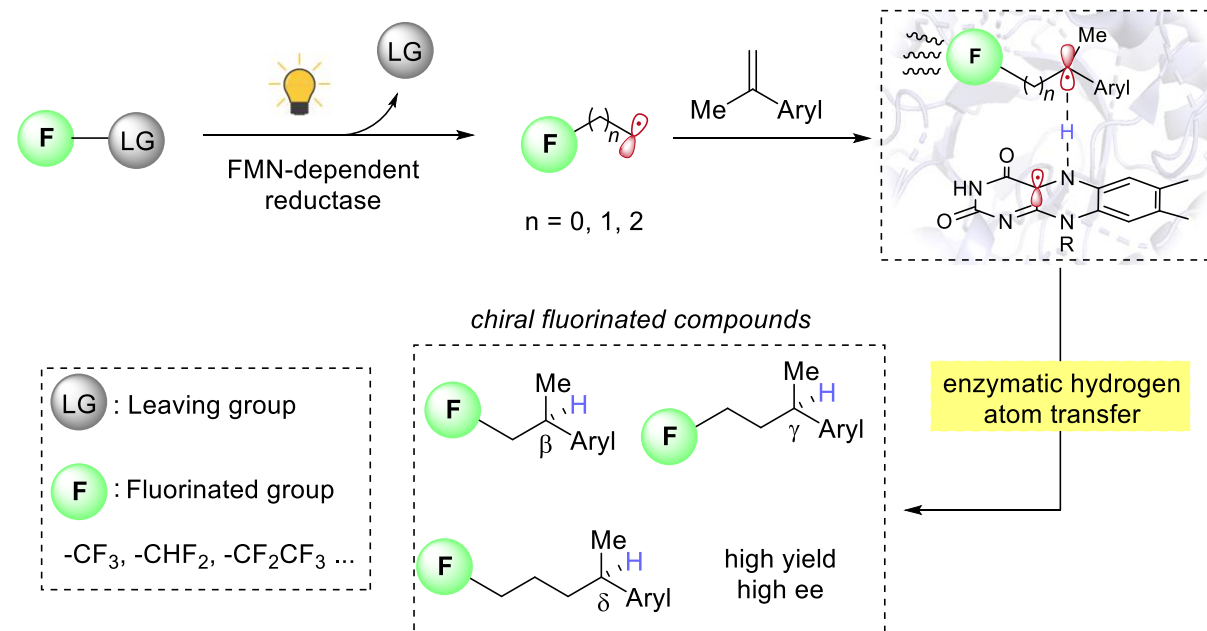
Results

OYE3 was identified as the optimal catalyst, achieving high yield (80%) and 93% enantioselective excess (ee). Various fluoroalkyl groups were incorporated into different substrates with yields of 37-99% and enantioselectivities of 69-99% ee. Key tyrosine residues were crucial for substrate binding and stereocontrol.

Significance/Impacts

This novel enzymatic strategy fills a gap in biocatalysis, enabling the synthesis of highly enantioselective fluorinated compounds, with significant applications in agrochemicals, and advances understanding of enzymes for optimized biocatalytic processes.

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The photoenzymatic process produces chiral fluorinated compounds