OP1: Ring-Opening Metathesis Polymerization of Cyclohexene Derivatives for Chemically Recyclable Functional Polymers

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OP2: Leveraging Donor-Thiophene-Appended BODIPY Catalysts for Photon-Controlled Activation of Pyroptosis

*Hyeonji Rha[1], Jungryun Kim[1], Qihang Ding[1], Eunji Kim[1], Yujin Kim[1], Changyu Yoon[1], Huiyeon Moon[1], Jiyoung Yoo[1], Seokjin Hong[1], and Jong Seung Kim[1]**

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OP3: Aquaphotocatalysis for Dearomative [2+2] Cycloaddition of Alkenylsulfonyl Fluoride "OnWater"

*Soo Bok Kim[1], Dong Hyeon Kim[1], Han Yong Bae[1]**

[1]Department of Chemistry, Sungkyunkwan University

OP4: Design and Synthesis of LXR/SREBP-1c Signaling Pathway Inhibitors to Improve Hepatic Lipogenesis Disorders: Exploring the Role of SIRT6 Activation

*Naghyun Song[1], Long Huu Nguyen[1], Ye Eun Cho[1], Soyeong Kim[1,2], Yeonsoo Kim[1], Jinsook Kwak[1], Kyuwon Son[1], Eun Seo Jang[1], Taeyeon Hwang[3], Sang-Bum Kim[2], Sanghyun Kim[4], Oh-Bin Kwon[2], Sangok Kim[3], Seoung Rak Lee[1,5], Haeseung Lee[1,5], Seonghwan Hwang[1,5], and Hwayoung Yun[1,5]**

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OP5: Achieving Precise Control over Molecular Periphery through Modular Synthesis

*Seongrok Shin[1], Hwon Kim[1], Jee Ho Ha[2], Kyoung Yeon Eun[2], Jiyeon Kim[1,3], Yeram Kim[1,4], Wonyoung Choe[1,3], Seok Ju Kang[2], Seung Kyu Min[1], Christopher W. Bielawski[1,4], Young S. Park[1]**

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OP6: Supramolecular Senolytics via the Intracellular Oligomerization of Peptides in Response to Elevated Reactive Oxygen Species Levels in Aging Cells

*Dohyun Kim[1], Sangpil Kim[1], Ja-Hyoung Ryu[1]**

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OP7: Utilizing Sacrificial Sulfoxide for the Synthesis of Highly Substituted Pyridine

*Jaehee Kim, Hyunghwan Seo, Hyewon Jang, KyeSung Park and Yonghoon Kwon**

[1]Department of Agricultural Biotechnology, Seoul National University
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OP8: Multi-dimensional Assessment of Chiral Catalyst through Multi-substrate Screening by ^{19}F NMR Spectroscopy and NMR-shift Reagent

*Donghun Kim, Gyeongseon Choi and Hyunwoo Kim**

Department of Chemistry, Korea Advanced Institute of Science and Technology

OP9: Regio- & Enantioselective Hydrofluorination of Unactivated Alkenes via Nickel-Hydride Catalysis

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OP10: Visible-Light-Driven Oxidation of Fe^{2+} Ions in Iron Gall Ink Formulation

*Hyunwoo Choi[1] and Insung S. Choi[1]**

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OP1

Ring-Opening Metathesis Polymerization of Cyclohexene Derivatives for Chemically Recyclable Functional Polymers

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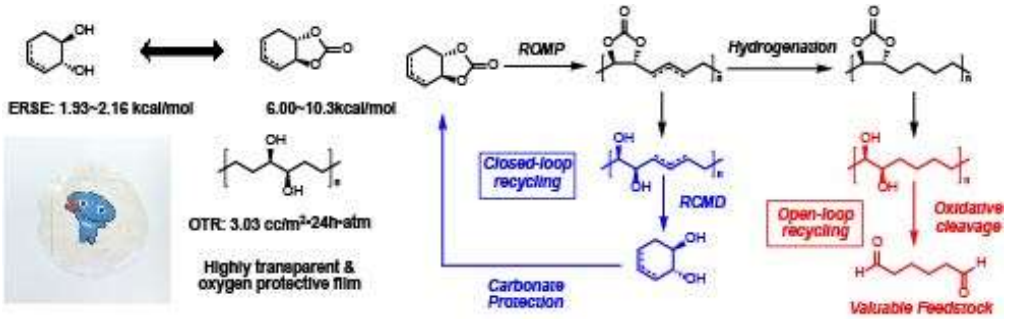
The ring-opening metathesis polymerization (ROMP) of six-membered cyclic olefins has posed a long-standing challenge due to their low ring strain energies (RSEs). In this study, we present the homopolymerization of versatile cyclohexene-derived monomers, producing oxygen-enriched, chemically recyclable polymers. An RSE-controlling functional group was employed on the cyclohexene to enable polymerization by increasing the RSE during the ROMP and to enable facile depolymerization by decreasing the RSE afterward. Specifically, the 1,2-diol groups of vicinal trans-cyclohexene-diols were converted into carbonate groups, facilitating highly efficient and controlled polymerization. The resulting cyclic carbonate fused polymers could be hydrolyzed under basic conditions to yield hydroxyl-group-enriched polymers with a well-defined 1,2-diol structure at every sixth carbon. We demonstrated closed-loop recycling through ring-closing metathesis depolymerization (RCMD) back to vicinal trans-cyclohexene-diols. Additionally, open-loop recycling was possible via oxidative cleavage of the 1,2-diol group, yielding industrially useful α,ω-dicarboxylic acids. These chemically recyclable and structurally well-defined 1,2-diol polymers exhibit high thermal and acid/base stability and excellent oxygen-blocking properties. The high thermal stability enabled the facile fabrication of highly transparent films with a wide range of mechanical properties.



Developed monomer and polymer structure and recycling pathways

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OP2

Leveraging Donor-Thiophene-Appended BODIPY Catalysts for Photon-Controlled Activation of Pyroptosis

Hyeonji Rha[a], Jungryun Kim[a], Qihang Ding[a], Eunji Kim[a], Yujin Kim[a], Changyu Yoon[a], Huiyeon Moon[a], Jiyoung Yoo[a], Seokjin Hong[a], and Jong Seung Kim[a*]

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Photon-controlled pyroptosis activation has recently received considerable attention by repurposing traditional photomodalities and utilizing their exceptional advantages. However, there have been limited studies on photocatalyst-mediated pyroptosis activation. In this study, we have developed heavy-atom-free BODIPY-based photocatalysts (TPA-th-BDP, DP-Bth-BDP, and Cbz-Bth-BDP) for precise photon-triggered pyroptosis activation through molecular engineering of thiophene-appended donors at the 2,6-position on the BODIPY core. Among these new BODIPY photocatalysts (D-th-BODIPY PCs), the carbazole-benzothiophene-appended BODIPY PC, Cbz-Bth-BDP, shows the highest photocatalytic activities, including ROS production and photocatalytic transformations of biological substances such as nicotinamide adenine dinucleotide (NADH) and cytochrome c (Cyt c). Using Density Functional Theory (DFT) calculations and cyclic voltammetry (CV) measurements, we demonstrate that Cbz-Bth-BDP has not only a negligible singlet-triplet energy gap (ΔES2T1, 0.02 eV) with a high spin-orbit coupling (SOC) value (3.95 cm^{-1}) but also a higher redox potential (-0.958 eV). These characteristics lead to efficient intersystem crossing (ISC) and photocatalytic activities. Upon green-light irradiation, photocatalytic NADH oxidation, Cyt c reduction, and disruption of cellular metabolism via inhibition of ATP production are observed in Cbz-Bth-BDP-treated MDA-MB-231 cells. Specifically, photoexcited Cbz-Bth-BDP induces significant pyroptotic responses, including gasdermin E (GSDME) activation, intracellular lactate dehydrogenase (LDH) release, and cellular swelling. Therefore, Cbz-Bth-BDP emerges as a promising candidate for precise photon-triggered pyroptosis activation, offering a new approach in cancer treatment strategies.

1. V. Nguyen et al. Molecular Design of Highly Efficient Heavy‐Atom‐Free Triplet BODIPY Derivatives for Photodynamic Therapy and Bioimaging. *Angew. Chem. Int. Ed.,* 59(23), **2020**, 8957–8962.

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OP3

Aquaphotocatalysis for Dearomative [2+2] Cycloaddition of Alkenylsulfonyl Fluoride "On-Water"

Soo Bok Kim[1], Dong Hyeon Kim[1], Han Yong Bae[1]

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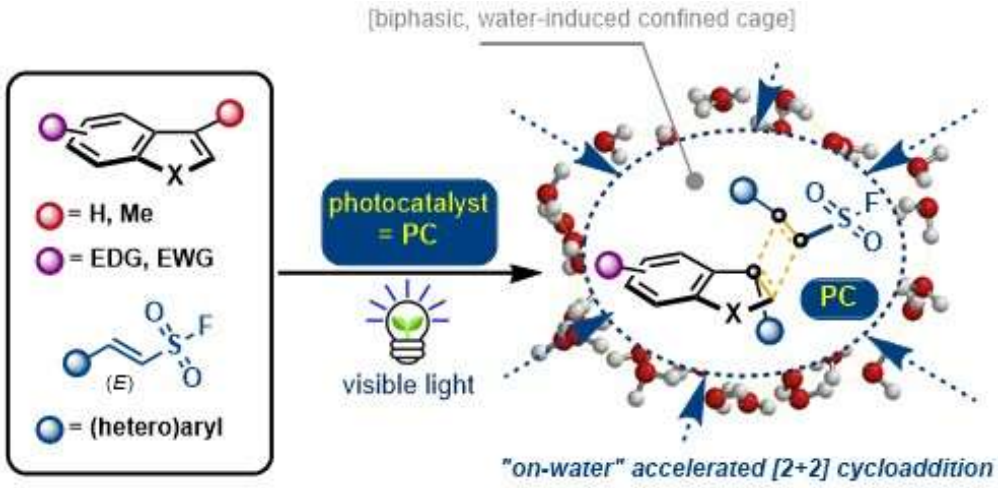
Since the emergence of sulfur(VI) fluoride exchange (SuFEx) chemistry, the development of compounds containing sulfonyl fluoride groups and their synthetic methods have been a notable area of research. Nevertheless, access to the construction of alkyl sulfonyl fluoride moiety has been limited, and it is still challenging to build a new alkyl SuFExable library while satisfying the development of a sustainable approach required in modern organic chemistry. In this context, converting alkenylsulfonyl fluorides to alkyl sulfonyl fluorides via aquaphotocatalysis will be a crucial approach to meet the demands of modern organic chemistry. In this presentation, we report a dearomative [2+2] cycloaddition to access alkyl SuFEx hubs “on-water”. The high-pressure effect of bulk water as a reaction medium is likely to accelerate the progress of the Dexter energy transfer mechanism via visible light-mediated aquaphotocatalysis. In contrast, conventional organic solvents provide homogeneous reaction media for the progress of the reaction. This was inefficient and left photo-isomerization of the starting material inevitable.



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OP4

Design and Synthesis of LXR/SREBP-1c Signaling Pathway Inhibitors to Improve Hepatic Lipogenesis Disorders: Exploring the Role of SIRT6 Activation

Naghyun Song[1], Long Huu Nguyen[1], Ye Eun Cho[1], Soyeong Kim[1,2], Yeonsoo Kim[1], Jinsook Kwak[1], Sang-Bum Kim[2], Oh-Bin Kwon[2], Seonghwan Hwang[1,3], and Hwayoung Yun[1,3,*]

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Dysregulation of hepatic De novo lipogenesis can lead to increased liver fat content and ultimately result in steatotic liver diseases. DNL is tightly regulated at the transcriptional level by various transcription factors, among which LXR and SREBP-1c play a crucial role by enhancing the expression of lipogenic enzymes such as fatty acid synthase (FAS), acetyl CoA carboxylase (ACC), and stearoyl CoA desaturase. Consequently, the LXR/SREBP-1c pathway presents a promising therapeutic target for treating fatty liver diseases by reducing lipid production. Recent research has identified SIRT6, an epigenetic enzyme, as a regulator of hepatic lipogenesis through the suppression of LXRα and SREBP-1c; however, the development of novel SIRT6 activators remains underexplored. To discover new anti-lipogenic agents, we have introduced a new scaffold based on a bioisosteric approach. A series of *N*-aryl-*N*′-[4-(aryloxy)cyclohexyl]squaramide derivatives were designed, synthesized, and evaluated for their effects on SREBP-1c expression and transcriptional activity. Structure-activity relationship (SAR) studies combined with two-step structural optimization led to the identification of the most potent compounds, **30** and **31**. Subsequent experiments demonstrated that compound **31** significantly inhibited LXR and SREBP-1c while also inducing SIRT6 activation in hepatocytes. In vivo studies using high-fat-diet-fed mice further confirmed that compound **31** reduced liver fat and restored liver function. This work advances the search for specific treatments for fatty liver disease.

OP5

Achieving precise control over molecular periphery through modular synthesis

Seongrok Shin,[1] Hwon Kim,[1] Jee Ho Ha,[2] Kyoung Yeon Eun,[2] Jiyeon Kim,[1,3] Yeram Kim,[1,4] Wonyoung Choe,[1,3] Seok Ju Kang,[2] Seung Kyu Min,[1] Christopher W. Bielawski,[1,4] Young S. Park[1]

[1]*Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST)*
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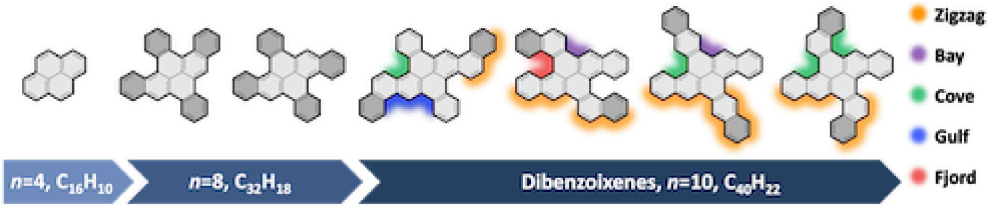
Nanographenes and polycyclic aromatic hydrocarbons, both finite forms of graphene, are promising organic semiconducting materials because their optoelectronic and magnetic properties can be modulated through precise control of their molecular peripheries. Several atomically precise edge structures have been prepared by bottom-up synthesis; however, no systematic elucidation of these edge topologies at the molecular level has been reported. Herein, we describe rationally designed modular syntheses of isomeric dibenzoixenes with diverse molecular peripheries, including cove, zigzag, bay, fjord, and gulf structured. The single-crystal structures of dibenzo[*a*,*p*]ixene and dibenzo[*j*,*y*]ixene reveal enantiomeric pairs with helically twisted cove edges and packing structures. The molecular edge structures are identified from the C–H bonds of the dibenzoixenes using Fourier-transform infrared spectroscopy with different vibrational modes, which were further explained using density functional theory calculations. Electron spin resonance spectroscopy indicate that the zigzag-edged molecular periphery significantly affects the magnetic properties of the material. Furthermore, the electrochemical characteristics, examined using dibenzoixenes as anode materials in Li-ion batteries, reveal that the dibenzo[*a*,*p*]ixene exhibits promising Li intercalation behaviors with a specific capacity of ~120 mAh g^{-1}. The findings of this study could facilitate the synthesis of larger π-extended systems with engineered molecular peripheries and potential application in organic electronics.



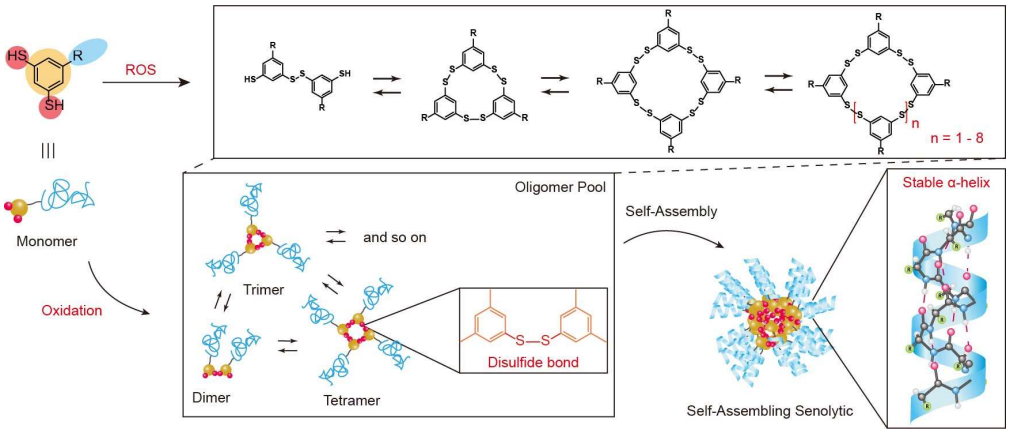
OP6

Supramolecular Senolytics via the Intracellular Oligomerization of Peptides in Response to Elevated Reactive Oxygen Species Levels in Aging Cells

Dohyun Kim[1], Sangpil Kim[1], Ja-Hyoung Ryu[1*]

[1]*Department of Chemistry, Ulsan National Institute of Science and Technology*

Senolytics, which eliminate senescent cells from tissues, represent an emerging therapeutic strategy for various age-related diseases. Herein, we constructed self-assembling senolytics targeting senescent cells with an intracellular oligomerization system. This oligomerization results in an artificial protein-like nanoassembly with a stable α-helix secondary structure, which can disrupt the mitochondrial membrane via multivalent interactions because the mitochondrial membrane of senescent cells has weaker integrity than that of normal cells. These three specificities (integrin $\alpha_v\beta_3$, high ROS, and weak mitochondrial membrane integrity) of senescent cells work in combination; therefore, this intramitochondrial oligomerization system can selectively induce apoptosis of senescent cells without side effects on normal cells. Significant reductions in key senescence markers and amelioration of retinal degeneration were observed after elimination of the senescent retinal pigment epithelium by this peptide senolytic in an age-related macular degeneration mouse model and in aged mice, and this effect was accompanied by improved visual function. This system provides a strategy for the treatment of age-related diseases using supramolecular senolytics.



Intramitochondrial oligomer pool generated by oligomerization via disulfide bond formation.

1. S. Kim ‡ , J.-B. Chae ‡ , D. Kim ‡ , C.-W. Park, Y. Sim, J. Kim, H. Lee, G. Park, J. Lee, S. Hong, B. Jana, C. Kim, H. Chung,* J.-H. Ryu*, *J. Am. Chem. Soc.*, 145(40), **2023**, 21991-22008

OP7

Utilizing Sacrificial Sulfoxide for the Synthesis of Highly Substituted Pyridine

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Pyridines are one of the common structures found in natural products and are also frequently used as ligands or catalysts. There had been various ways for synthesizing, but methods for highly substituted pyridines were limited. In our study, a new cascade benzannulation method was proposed. From a conveniently prepared “Gadget” vinylcarbinoxy vinyl sulfoxide under thermal conditions, the highly substituted pyridine was synthesized through Claisen rearrangement, sulfoxide elimination, imine condensation, 6-π electrocyclization, and auto-oxidation. Furthermore, a modification of the condition brought the additional introduction of a thioether bond at the inactive meta position of pyridine. The introduction was caused by unprecedented recycling processes of the sulfoxide elimination and the thioether bond was proved to be verified as a cross-coupling partner. As a result, a new synthetic method for multi-substituted pyridine was established. We share details in this talk.

OP8

Multi-dimensional Assessment of Chiral Catalyst through Multi-substrate Screening by ^{19}F NMR Spectroscopy and NMR-shift Reagent

Donghun Kim, Gyeongseon Choi and Hyunwoo Kim

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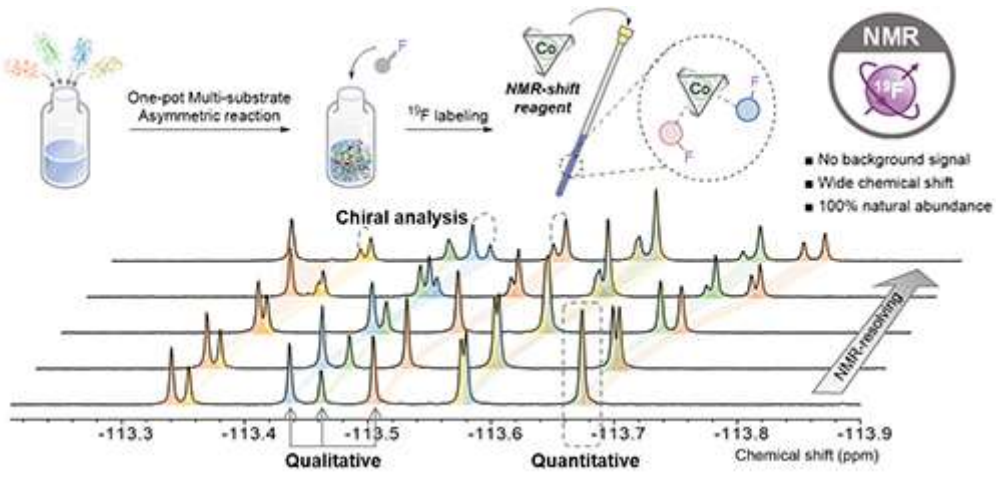
Exploring a broad chemical space is crucial for understanding asymmetric catalysis.[1] However, the complex nature of chiral catalysts makes this process resource-intensive and necessitates strategic approaches.[2] Multi-substrate screening is a promising strategy, but analyzing the resulting mixtures is challenging and often relies on chromatography-based equipment for static separation.[3] In our study, we utilized NMR spectroscopy to analyze both yield and enantiomeric excess in mixtures. By using ^{19}F NMR spectroscopy, we effectively distinguished various compounds.[4] The use of NMR-shift reagents provided splitting patterns for each enantiomer, illustrating the separation process in stages and greatly expanding the potential for simultaneous analysis. We conducted asymmetric reductive amination reactions on 21 different ketone substrates in a single run and successfully analyzed the results. This approach enabled us to explore a broad chemical space for chiral ruthenium catalysts and achieve advancements in catalyst development through strategic screening.



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2. Wagen, C. C.; McMinn, S. E.; Kwan, E. E.; Jacobsen, E. N. *Nature* **2022**, *610*, 680-686.
3. Fogel, M. S.; Koide, K. *Org. Process Res. Dev.* **2023**, *27*, 1235-1247.
4. Jang, S.; Park, H.; Duong, Q. H.; Kwahk, E.; Kim, H. Anal. Chem. 2022, 94, 1441-1446.

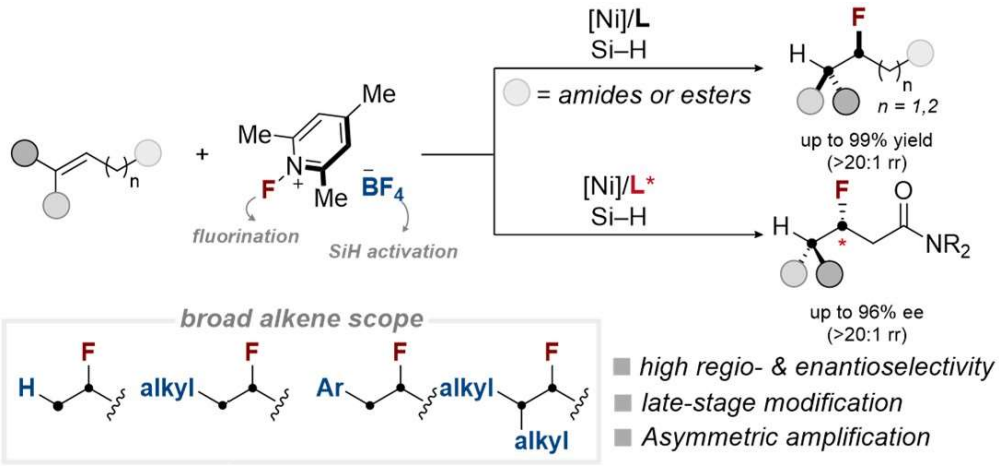
OP9

Regio- & Enantioselective Hydrofluorination of Unactivated Alkenes via Nickel-Hydride-Catalysis

Minseok Kim, Sungwoo Hong

[1] *Department of Chemistry, Korea Advanced Institute of Science and Technology*
[2] *Center for Catalytic Hydrocarbon Functionalizations, Institute for Basic Science*

The catalytic formation of a regio- and enenatioselective C–F bond formation from easily accessible alkenes is a critical objective, but it remains a major challege in organic synthesis. In this study, we demonstrate the regioselectibe formation of C–F bonds using NiH catalysis combined with a coordination directing approach that allows for precise hydrofluorination of both terminal and internal alkenes. Importantly, we have refined this methods to achieve high enantioselectivity in generating alphatic C–F stereogenic centers, particularly with β,γ-alkenyl substrates, by utilizing a tailored chiral Bn-BOx ligand. A key discovery in our research is the observation of the (+)-nonlinear effect under optimized conditions, which enables high enantioselectivity even with chiral ligands that are only moderately enantiomerically enriched. Considering the importance of fluorine in pharmaceuticals and synthetic materials, this work provides valuable insights into the regioselective and enantioselective formation of C–F bond chiral centers, facilitating the efficient synthesis of important fluorinated compounds.



1. Lee, C. ‡ ; Kim, M. ‡ ; Han, S.; Kim, D.; Hong, S. *J. Am. Chem. Soc.* **2024**, *146*, 9375–9384.

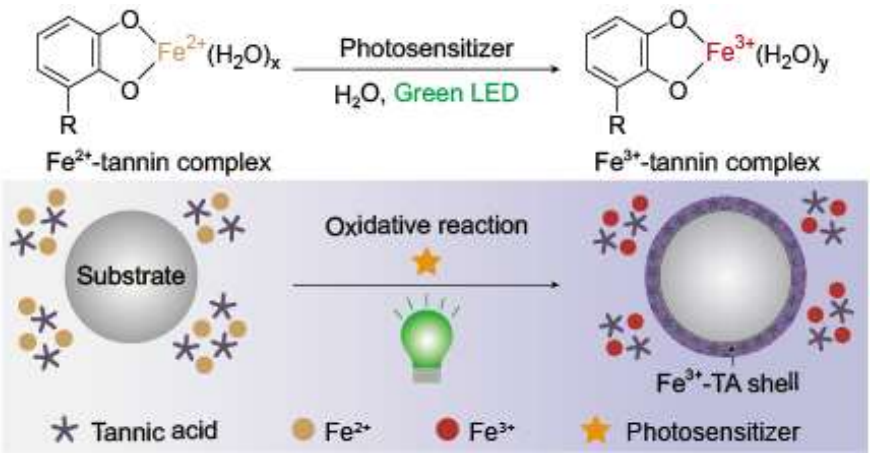
OP10

Visible-Light-Driven Oxidation of Fe^{2+} Ions in Iron Gall Ink Formulation

Hyunwoo Choi[1] and Insung S. Choi[1]

[1]*Department of Chemistry, KAIST, Korea*

Recent research in interface engineering, including cell-surface modification, has explored the chemistry behind iron gall ink, a substance used since the Middle Ages in Europe, derived from oak galls and iron(II) sulfate.[1-4] In the traditional recipe, tannins from the oak galls, such as tannic acid (TA) and gallic acid, form water-soluble Fe^{2+}-tannin complexes, which subsequently darken into a semi-infinite network of Fe^{3+}-tannin complexes upon the oxidation of Fe^{2+} to Fe^{3+} ions in air, creating the characteristic ink. Although the indirect use of Fe^{2+} ions, inspired by iron gall ink, has proven effective in the continuous formation of Fe^{3+}-TA films and shells up to micrometers thick, the air oxidation of Fe^{2+} ions is extremely slow and challenging to control spatiotemporally. This research leverages the unique properties of photoreactions to both accelerate the Fe^{2+} oxidation and achieve precise spatiotemporal control over the formation of Fe^{3+}-TA films and shells.



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