

Defluorophosphinylation Synthesis of Aryl Phosphorus Compounds

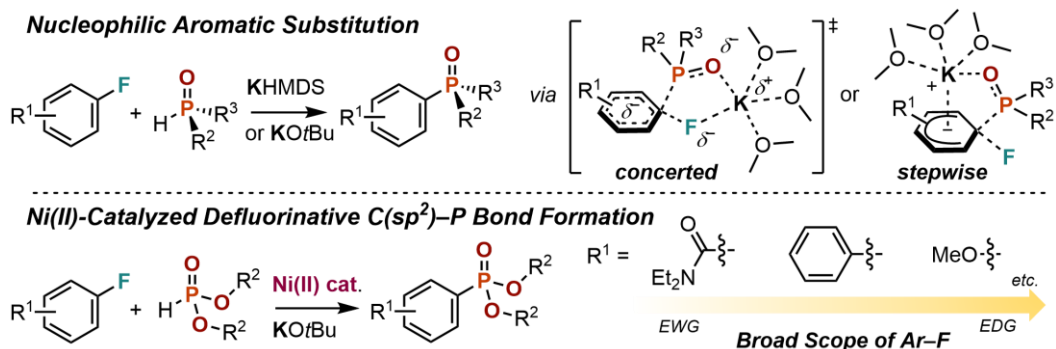
(¹Department of Chemistry, Faculty of Science, Hokkaido University, ²WPI-ICReDD, ³Department of Basic Science, Graduate School of Art and Sciences, The University of Tokyo)
 ○Zhensheng You,¹ Kosuke Higashida,^{1,2} Tomohiro Iwai,³ Masaya Sawamura^{1,2}

Keywords: Defluorophosphinylation; Aryl Fluorides; Aryl Phosphorus Compounds; Nucleophilic Aromatic Substitution; Quantum Chemical Calculation

Nucleophilic aromatic substitution (S_NAr) is a classical and fundamental chemical reaction. The S_NAr reactions occur most commonly between strong nucleophilic reagents and aryl halides with strongly electron-withdrawing substituents, proceeding through a widely-accepted stepwise manner intermediated by Meisenheimer complexes. Meanwhile, a series of reports have revealed that electron-neutral and electron-deficient aryl electrophiles prefer a concerted manner without the presence of an intermediate (CS_NAr). Generally, mechanisms in S_NAr are dominated by electronic properties of electrophiles rather than nucleophiles.¹

Herein, we report a new S_NAr reaction. Non-activated aryl fluorides reacted with potassium diorganophosphinites ($KOPR^1R^2$) prepared *in-situ* from secondary phosphine oxide [$H(O)PR^1R^2$] and potassium bases such as $KHMDS$ and $KOtBu$.² A variety of aryl fluorides, including strongly electron-rich *p*-fluoroaniline derivatives, participated in the reaction with the substantially stabilized anionic P-nucleophiles, forming the corresponding tertiary phosphine oxides. Quantum chemical calculations revealed a nucleophile-dependent mechanism, which involves both stepwise and concerted S_NAr reaction pathways. This is due to non-covalent interactions and ambiphilic nature of the potassium diorganophosphinite nucleophiles.

Moreover, the addition of a catalytic amount of a Ni(II) complex enables the defluorinative $C(sp^2)-P$ bond formation reaction of aryl fluorides with diorganophosphites [$H(O)P(OR)_2$] using $KOtBu$ as a base. A wide range of electron-rich and electron-deficient aryl fluorides participated in this Ni catalysis without an exogenous ligand.



- 1) Rohrbach, S.; Murphy, J. A.; Tuttle, T. *J. Am. Chem. Soc.* **2020**, *142*, 14871–14876
- 2) You, Z.; Higashida, K.; Iwai, T.; Sawamura, M. *Angew. Chem., Int. Ed.* in press (DOI: 10.1002/anie.202013544).