# Reuse of Recovered Fluorocarbons by Direct Chemical Transformation

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[Abstract]

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Although fluorocarbons have been widely used as refrigerants and fire extinguishing agents, they are now subject to close regulation because of their ozone-depleting and greenhouse effects, and thus their recovery is an urgent task. In addition, most of recovered fluorocarbons are treated by combustion at present, in which carbon skeletons and fluorine of fluorocarbons are lost. To solve this problem, we investigated methods for recycling fluorocarbons by chemical transformation into high value-added compounds using synthetic organic chemistry.

The carbon-fluorine bond of fluorocarbons is a stable chemical bond with high bond energy. However, our research group has recently developed an efficient method for converting carbon-fluorine bonds by metal catalysts or acids under mild conditions, called “fluorine elimination”. In this research, we developed various methods for chemical transformation of fluorocarbons based on the “fluorine elimination” strategy.

Herein we achieved an efficient chemical conversion of one of hydrofluorocarbons (HFCs), which have served as alternative chlorofluorocarbons (CFCs), to fluorine-containing heterocyclic compounds using a copper catalyst. We also succeeded in producing fluorine-containing alkene and arene compounds from hydrofluoroolefins (HFOs), next-generation refrigerants, using a nickel catalyst. Furthermore, we also developed reactions of fluorocarbon-like fluorine-containing small molecules. These reactions are expected to be applied to fluorocarbons in the future. The fluorine-containing small molecules including chlorofluorocarbons usually contain multiple fluorine atoms, and the reaction developed in this research can selectively cleave only some of these fluorines, leaving fluorine in the obtained products. Nowadays, fluorine-containing compounds have attracted much attention in pharmaceutical, agrochemical, and materials sciences. In particular, fluorine-containing heterocyclic compounds are widely used as pharmaceuticals and agrochemicals. Fluorine-containing alkenes and arenes are promising candidates for monomers toward functional polymers and organic semiconductors, respectively. Thus, we opened up the possibility of recycling, or even up-cycling, fluorocarbons into useful compounds. Furthermore, as the stable supply of fluorine has recently become difficult, we expect that the effective use of fluorine atoms contained in fluorocarbons will contribute to building a society that recirculates fluorine resources.

[References]

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