Organic synthesis, Drug discovery, Organic materials

Transition-metal-free arylamine synthesis utilizing hypervarent iodines

Department of Applied Chemistry, Graduate School of Engineering
Assistant Professor Kensuke Kiyokawa
Researchmap https://researchmap.jp/kensukekiyokawa?lang=en

Abstract

Aromatic amines are an important class of compounds widely utilized in pharmaceuticals, agrochemicals, and organic materials, and the development of efficient methods for their synthesis remains a key challenge in organic chemistry. In this study, we successfully synthesized novel hypervalent iodine reagents (aminoiodanes) bearing various amino groups on the iodine atom and discovered that they promote the electrophilic amination of arylboronic acids. This method enables the synthesis of a wide range of aromatic amines without the use of transition metals and can be applied to the preparation of compounds that are difficult to access by conventional methods.

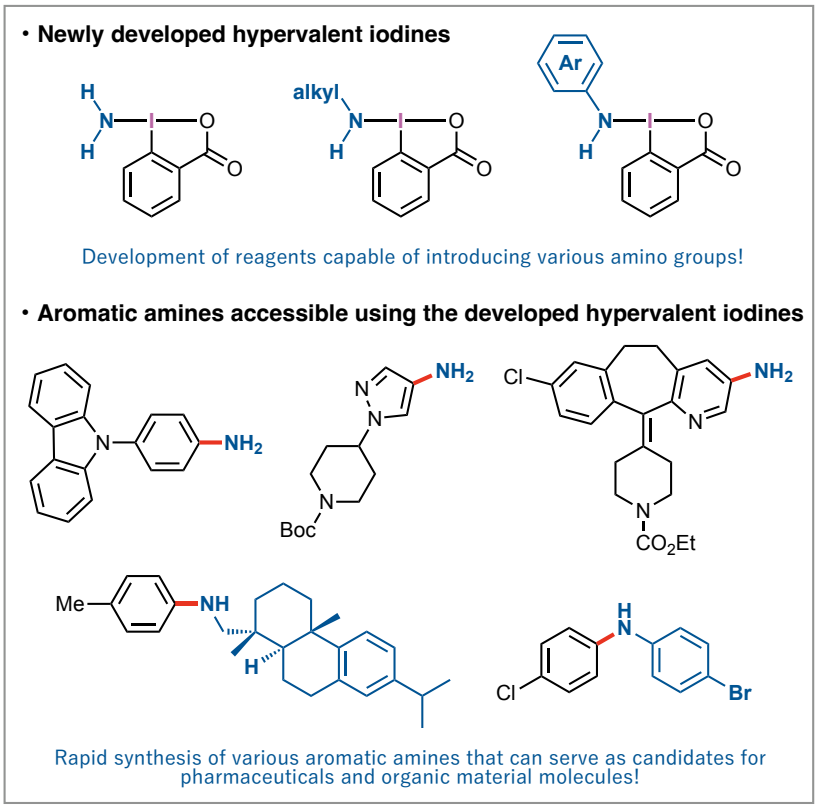
Background & Results

The method developed in this study has great potential to advance the synthesis of pharmaceuticals and organic materials, as it enables the preparation of a wide variety of aromatic amines without the use of transition-metal reagents. This is particularly important because even trace amounts of residual metals can cause toxicity in pharmaceuticals and significantly affect the physical properties of organic materials. Furthermore, the simplified reaction process reduces energy consumption, thereby contributing to lower environmental impact, more efficient use of resources, and ultimately, the realization of a sustainable society.

Significance of the research and Future perspective

Aromatic amines are an important class of compounds widely used in pharmaceuticals, agrochemicals, and organic materials, and the development of efficient methods for their synthesis remains a key challenge in organic chemistry. The synthesis of arylamines is most commonly achieved through carbon–nitrogen bond-forming reactions, among which transition-metal-catalyzed methods have been extensively developed. However, in the synthesis of fine chemicals, complete removal of residual metals from the products is required, which entails considerable labor and cost. Therefore, the development of efficient synthetic methods that do not rely on transition metals is highly desirable.

In this study, we successfully synthesized novel hypervalent iodine reagents (aminoiodanes) bearing various amino groups on the iodine atom and found that they promote the electrophilic amination of arylboronic acids. This method enables the efficient synthesis of a wide range of aromatic amines without the use of transition metals and allows access to compounds that are difficult to obtain by conventional methods.



Patent

Treatise
Kiyokawa, Kensuke; Kawanaka, Kazuki; Minakata, Satoshi. Amino-λ³-iodane-enabled electrophilic amination of arylboronic acid derivatives. Angew. Chem. Int. Ed. 2024, 63(12), e202319048. doi: 10.1002/anie.202319048
Kawanaka, Kazuki; Kiyokawa, Kensuke; Minakata, Satoshi et al. Versatile method for the synthesis of aminobenziodoxolones and its application to one-pot coupling of arylboronic acids with simple amines. Chem. Sci. 2025, 16(41), 19389-19396. doi: 10.1039/D5SC06301A

U R L http://www.chem.eng.osaka-u.ac.jp/~minakata-lab/english/index.html

Keyword organic synthesis, aromatic amines, iodine, drug discovery, organic materials