Sodium Iodide

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Introduction

Sodium iodide (NaI) occurs as colorless, odorless or as a white crystalline solid; it is slightly hygroscopic, and a commercially available reagent. It is soluble in water, alcohols, acetone, and other organic solvents and stable under normal temperature and pressure (mp: 651 °C, d = 3.67 g/cm³).¹ On a laboratory scale, sodium iodide may be prepared by neutralizing a solution of sodium hydroxide or sodium carbonate with hydriodic acid.² Sodium iodide is a very useful and versatile reagent for the synthesis of various types of organic compounds. For example, an important application of this reagent involves the conversion of an alkyl chloride or alkyl bromide to an alkyl iodide by the addition of sodium iodide in acetone (Scheme 1).³ This nucleophilic substitution reaction, also known as Finkelstein reaction, may proceed via either an SN1 or SN2 mechanism depending on the nature of the alkyl halide.⁴⁻⁵

Abstracts

(A) Möker and Thiem showed that the 4′-chloro substituent of the 6-O-(4′-chlorobutyl)-1,2,3,4-di-O-isopropylidine-a-D-galactopyranose was replaced by iodide in acetone under reflux for 24 h in a Finkelstein reaction to give the product 3-O-(4′-iodobutyl)-1,2,5,6-di-O-isopropylidine-a-D-glucofuranose in 85% yield.⁵

(B) Eras et al. reported that 0.5 equivalent of sodium iodide (NaI) in butanone and the presence of a reducing agent like sodium thiosulfate induce the formation of the corresponding allyl esters 2, starting from 2-chloro-1-(chloromethyl)ethyl alkyl or aryl esters 1 by the Finkelstein rearrangement–elimination reaction.⁷

Scheme 1

This reaction has been expanded to include the conversion of alcohols into alkyl halides by first converting the alcohol into a sulfonate ester (tosylates or mesylates are usually used), and then performing the substitution.⁸ Other applications using sodium iodide as reagent in organic synthesis have been reported. They include the Finkelstein rearrangement–elimination reaction of 2-chloro-1-(chloromethyl)ethyl esters induced by NaI,⁷ the Diels–Alder reaction between a,a,d,a′,a″-tetrabromo-oxylene and 2-cyclopentenone in the presence of NaI,⁸ monoiodination of arenes by alkali metal iodide,⁹ transformation of azides to primary amines using the CeCl₃·7H₂O/NaI system,¹¹ and Michael addition of nucleophiles to alkenes promoted by the CeCl₃·7H₂O/NaI system supported on alumina.¹²
(C) Meyer and Hergenrother described the synthesis of 2,3-disubstituted naphthalene by Diels–Alder aromatization reaction between \( \alpha,\alpha,\alpha',\alpha'' \)-tetrahalo-\( o \)-xylene and a 2-pentanone derivative in the presence of sodium iodide in DMF.\(^5\)

![Diagram of the reaction]

(D) Recently, Firouzabadi et al. reported a new environmentally friendly catalytic method for the efficient mononiodination of arenes. The method is based on using sodium iodide, hydrogen peroxide (35%) and cerium(III) chloride as an effective catalyst in water under reflux conditions. This method can also be applied easily in the syntheses of iodinated cyclic ethers and iodinated lactones from their corresponding unsaturated alcohols and carboxylic acids in high yield.\(^6\)

![Diagram of the reaction]

(E) A new method for the conversion of aryl, heteroaryl, and vinyl bromides into the corresponding iodides utilizing NaI, a catalyst system comprising CuI and a 1,2- or 1,3-diamine ligand was developed by Klapars and Buchwald. This method gives products in excellent yield.\(^10\)

![Diagram of the reaction]

(F) Bartoli and co-workers described a simple and efficient method of converting azides into exclusively primary amines using NaI in the presence of inexpensive CeCl\(_3\)·7H\(_2\)O in refluxing acetonitrile or under microwave-assisted irradiation.\(^11\)

![Diagram of the reaction]

(G) Bartoli and co-workers have also reported the hetero-Michel addition of nucleophilic nitrogen compounds to electron-poor alkenes promoted by the CeCl\(_3\)·7H\(_2\)O/NaI system supported on alumina under solvent-free conditions.\(^12\) The resulting \( \beta \)-amino derivatives are versatile synthons for the synthesis of many nitrogen-containing biologically important compounds.

References


