SYNLETT
Spotlight 446

This feature focuses on a reagent chosen by a postgraduate, highlighting the uses and preparation of the reagent in current research

1,3-Diiodo-5,5-dimethylhydantoin

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Introduction

1,3-Diiodo-5,5-dimethylhydantoin (DIH, $C_5H_6I_2N_2O_2$, mp 192–196 °C, CAS: 2232-12-4) is a light brown powder. It has a light iodine odor and is stable when kept dry and at low temperature.

In 1965, Orazi et al. introduced DIH as an efficient reagent for iodination.[1] DIH is a stable compound with a high iodine content. Mechanistic studies suggest that this reagent acts as an I^+ donor. Homolytic cleavage could not be detected and no HI is formed. Therefore, additional bases or oxidants are not required!

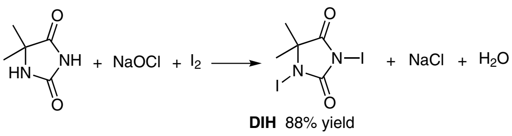
DIH has a reactivity comparable to that of molecular iodine, but it is more convenient to handle, because this solid reagent does not sublimate. It possesses the same selectivity as *N*-iodosuccinimide (NIS) and equal or better halogenating ability. With two N–I bonds, DIH can be more economical in direct comparison to NIS. It has been used as an iodizing agent or an oxidizing agent in production processes in the pharmaceutical, food, and agricultural industries.

DIH has been used for chemoselective iododesilylations[2] to obtain nitriles,[3,4] for the iodination of aromatic compounds,[5] for the preparation of chroman derivatives,[6] to convert aromatic aldehydes into the corresponding amides,[7] for the sulfonylamidation of alkylbenzenes at the benzylic position,[8] and to obtain oxazolonederivatives,[9] benzothiazine, and tetrahydroquinoline[10] derivatives.

Preparation

DIH was firstly prepared by Orazi et al. in 1965 by reacting iodine monochloride under basic conditions[1] with 5,5-dimethylhydantoin.

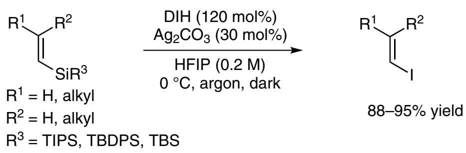
Recently, Mima[11] prepared DIH from an iodide source (like molecular iodine and sodium iodide) and 5,5-dimethylhydantoin with hypochlorite salts.



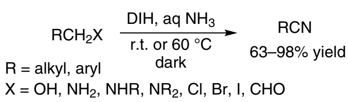
Scheme 1 Preparation of DIH from 5,5-dimethylhydantoin

Abstracts

(A) Sidera et al.[2] reported the chemoselective iododesilylation of TIPS-, TBDPS-, and TBS-substituted alkenes with DIH. Such (*Z*- and *E*-) substituted alkenes could be transformed into vinyl iodides with retention of configuration in the presence of alkenes, alkynes, and silylated alkynes. Under these conditions, DIH is also efficient and does not affect O–Si bonds, epoxides, etc. The desired iodoalkenes are obtained stereospecifically without a byproduct.



(B) Iida and co-workers[3] reported a direct, efficient, practical and less toxic oxidative conversion of alcohols, amines, aldehydes and alkyl halides into nitriles with DIH in aqueous ammonia. Unlike the traditional method with toxic cyanide, which induces one-carbon homologation, the use of DIH allows to maintain the same number of carbon atoms.



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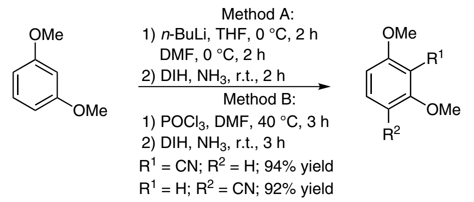
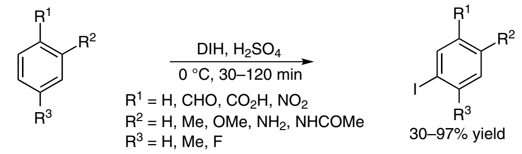
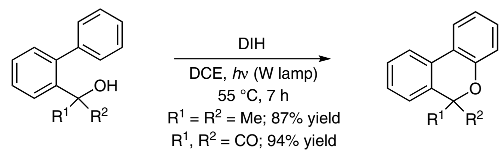
(C) A practical one-pot transformation of electron-rich aromatics into nitriles via aryllithiums and their DMF adducts[4a] and via Vilsmeier-Haack reaction[4b] has been accomplished by Ushijima et al. with DIH in aqueous ammonia. These new reactions are environmentally benign one-pot methods for the preparation of aromatic nitriles in good yields. The reactions bear several advantages: they are highly efficient, direct, practical, and have a low cost and toxicity. The reactions are transition-metal-free, cyanide-free and occur in one-pot; the regioselectivity depends on the used method.



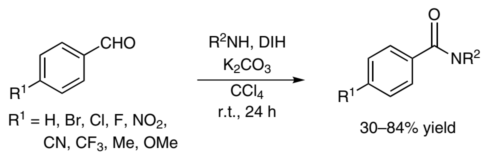
(D) Chaikowskii and co-workers[5] used DIH as an efficient reagent for iodination of aromatic compounds. The reactivity of the electrophilic iodine is controlled by the acidity of the medium. Good yields were obtained with electron-deficient arenes. With electron-rich arenes, polyiodination was observed at 20 °C.



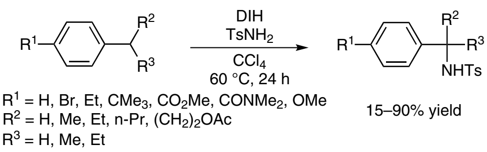
(E) Furuyama and Togo[6] have reported an efficient preparation of chroman derivatives with DIH under irradiation conditions with a tungsten lamp. The reaction proceeds via the formation of an alkoxy radical followed by radical cyclization onto the aromatic ring with DIH to provide the chroman derivative.



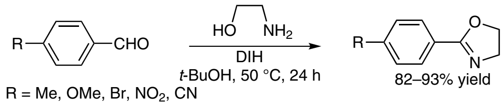
(F) Various *N*,*N*-dimethyl aromatic amides and *N*-aroyl morpholines bearing electron-withdrawing and electron-donating groups on the aromatic rings were synthetized in moderate to good yields by Baba and co-workers.[7] The reaction is simple, metal-free, and generates little waste. Heteroaromatic aldehydes give the corresponding amides in moderate to good yields.



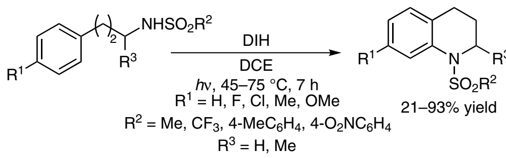
(G) Baba and Togo[8] reported a simple method for the sulfonylamidation of alkylbenzenes at the benzylic position with *p*-toluenesulfonamide and DIH in moderate to good yields. As DIH is not an hypervalent iodine compound, it can be used alone for the present radical reactions, instead of the combination of (diacetoxyiodo)-benzene and molecular iodine.



(H) Takahashi and Togo[9] reported an efficient oxidative conversion of aldehydes into 2-substituted 2-oxazolines using DIH in good to high yields. The reactivity of DIH is higher than that of molecular iodine, NIS and *tert*-butyl hypochlorite. This method is a useful alternative for the preparation of 2-substituted 2-oxazolines and chiral derivatives from aldehydes and amino alcohols.



(I) 1,2,3,4-Tetrahydroquinoline derivatives were synthesized in good yields with DIH under irradiation with tungsten lamp by Moroda et co-workers.[10] Initially, an N–I bond is formed in the sulfonamides derivatives followed by homolytic cleavage to afford the sulfonamidyl radical which cyclizes into the aromatic ring. Finally, the aromatic ring is oxidized with DIH. DIH is more efficient than molecular iodine.



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