

# SYNLETT Spotlight 257

## 1*H*-Benzotriazoles

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

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### Introduction

1*H*-Benzotriazole (BtH) is a non-volatile, white crystalline powder that melts at 98.5 °C. It is insoluble in water, but soluble in aqueous sodium carbonate, and in ethanol. It is intrinsically unreactive, stable under many conditions, cheap, and ready available. Because of its chemical properties, it can be used as a valuable synthetic auxiliary, allowing an enormous variety of reactions.<sup>1</sup> A benzotriazole group activates the carbon atom to which it is attached in various ways: by acting as a leaving group; by enabling deprotonation; or by acting as an electron donor. An attached benzotriazole group is also an ambient anion-directing group and it can act as a radical or carbanion precursor.<sup>1</sup>

1*H*-Benzotriazole is involved in several reactions, including: Bt-mediated N- and C-acylations;<sup>2</sup> imidoylation reac-

tions;<sup>3</sup> thioacylation and sulfonylations;<sup>4</sup> insertion reactions;<sup>5</sup> amido- and amino-alkylations;<sup>6</sup> synthesis of heterocycles;<sup>7</sup> and reactions involving the cleavage of a benzotriazole ring.<sup>8</sup> It can be also used in Wittig rearrangements, VNS (vicarious nucleophilic substitutions), and radical-mediated reactions.<sup>9</sup>

BtH can be prepared according to a simple procedure in which, to a cooled sodium nitrite solution, is added an aqueous *o*-phenylenediamine and glacial acetic acid solution (Figure 1).<sup>10</sup>

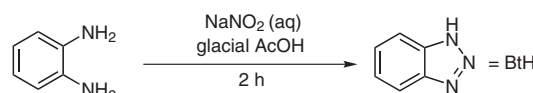
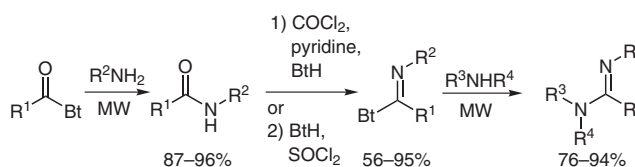


Figure 1

### Abstracts

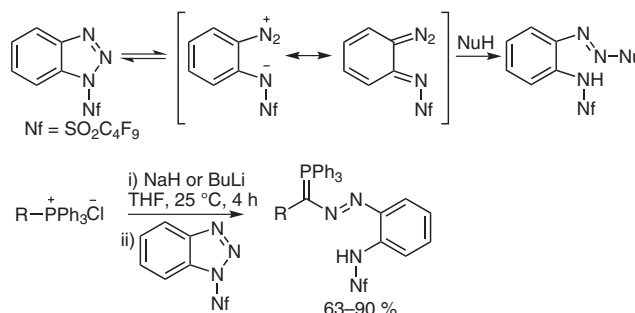
#### (A) Access to polysubstituted amidines:

The microwave synthesis of amides from *N*-acylbenzotriazoles and preparation of imidoylbenzotriazoles by a one-pot reaction of an amide, thionyl chloride (or oxalyl chloride), and benzotriazole was disclosed.<sup>11</sup> The direct synthesis of *N,N'*-disubstituted and *N,N,N'*-trisubstituted amidines was achieved by microwave irradiation of imidoylbenzotriazoles in a mild and general procedure.



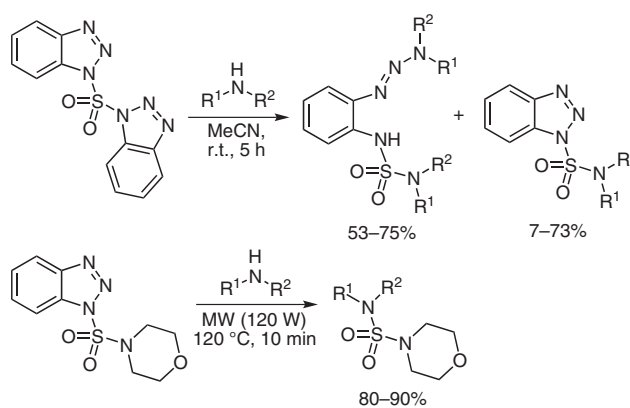
#### (B) Ring-opening reactions of benzotriazoles with Wittig reagents:

Nonfluorobutanesulfonyl-1*H*-benzotriazole undergoes a clean ring-opening reaction of the triazole moiety upon treatment with carbon nucleophiles.<sup>8</sup> It was shown that nonfluorobutanesulfonyl-1*H*-benzotriazole reacts with Wittig reagents via an intermediate to give the corresponding aryl- or alkylazomethylene triphenylphosphoranes.



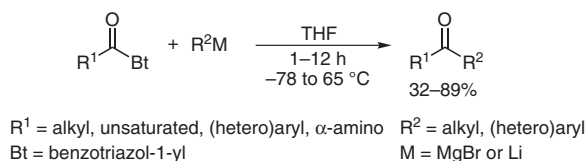
(C) Synthesis of *o*-sulfamidotriazobenzenes from 1,1'-sulfonylbis(benzotriazole):

1,1'-Sulfonylbis(benzotriazole) (Bt<sub>2</sub>SO<sub>2</sub>) reacts with secondary amines at room temperature to afford (i) the corresponding *o*-sulfamido-triazobenzenes via concurrent substitution of the first, and ring opening of the second, benzotriazolyl group, and (ii) *N*-sulfonylbis(benzotriazole)s. <sup>12</sup> 1-(Morpholine-4-sulfonyl)-1*H*-benzotriazole reacts with piperidine, pyrrolidine, and *N*-methylpiperazine under microwave irradiation to give the unsymmetrical sulfamides.



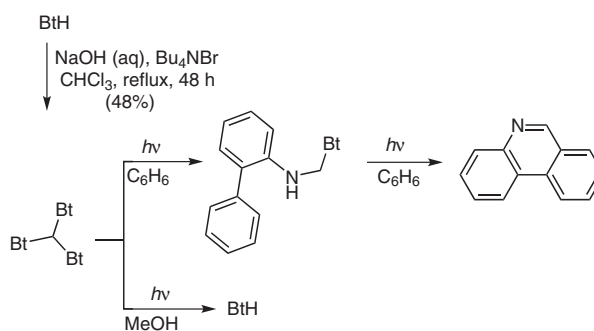
## (D) Amino ketones by acylation of organometallic reagents:

*N*-Acylobenzotriazoles react with Grignard reagents or heteroaryl-lithiums to give alkyl, unsaturated, (hetero)aryl, and  $\alpha$ -amino ketones without side reactions. <sup>13</sup>



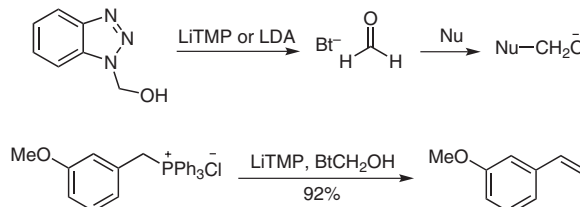
## (E) Photochemical study of tris(benzotriazol-1-yl)methane:

Tris(benzotriazol-1-yl)methane is described as a potential component that can extrude nitrogen molecules. <sup>14</sup> The benzotriazole ring is highly stable to acids and bases, oxidation and reduction, and heat, but it is known that when some benzotriazole derivatives are subjected to irradiation, nitrogen elimination is observed.



## (F) Anionic, in situ generation of formaldehyde:

This is an extremely simple, safe and versatile method for the in situ generation of anhydrous formaldehyde in organic solvents. <sup>15</sup> The reaction proceeds under basic conditions, allowing subsequent hydroxymethylation of carbanionic structures such as organometallics or enolates.



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