Abstract

Development Of Organic Synthetic Methods Using \( N,N \)-Dibromo-\( p \)-Toluene Sulfonamide

The thesis entitled “Development of Organic synthetic Methods Using \( N,N \)-Dibromo-\( p \)-Toluene Sulfonamide” comprises of eight chapters listed as follows.

Chapter 1. General Introduction

Chapter 2. Facile generation of vicinal bromoazides from olefins using TMSN\(_3\) and TsNBr\(_2\) without any catalyst.

Chapter 3. An efficient protocol for stereoselective epoxidation of cinnamic esters using TsNBr\(_2\).

Chapter 4. Regio and stereoselective synthesis of aminobromine from olefins using TsNBr\(_2\) without any catalyst.

Chapter 5. A simple and efficient bromoformyoxylation reaction using TsNBr\(_2\).

Chapter 6. A synthetic approach for the enantiopure bromohydrins using Evans Chiral auxiliary as chiral precursor and TsNBr\(_2\) as brominating agent.

Chapter 7. A rapid bromination of phenols using TsNBr\(_2\) as brominating agent.

Chapter 8. A facile noncatalytic pathway for the nitrene transfer process: expeditious access to aziridines.
CHAPTER 1

General Introduction

In this chapter, a general overview of the thesis is given which describes briefly about the importance of bromine and bromo organics. Due to the wide applicability of the bromo compounds, it is necessary to find out simple bromination procedures and efficient brominating agents. A short summary of different transformations using various bromo compounds is added with references. Then a brief write-up about titled reagent \( N,N\text{-dibromo-}p\text{-toluene sulfonamide} (\text{TsNBr}_2) \) has also been included in this chapter.

CHAPTER 2

Facile generation of vicinal bromoazides from olefins using TMSN\(_3\) and TSNBr\(_2\) without any catalyst

This chapter deals with the synthesis of vicinal bromoazides from olefins using TMSN\(_3\) and TSNBr\(_2\) without any catalyst. The reaction is extremely fast which goes into completion instantaneously to produce bromoazides. This procedure is applicable to various olefins such as cinnamates, chalcones, styrenes, and acrylate to give the corresponding 1,2-bromoazide in an excellent yield (Scheme 1).\(^1\)

\[
\begin{align*}
\text{R} & \quad \text{R}' & \quad \text{TsNBr}_2, \text{TMSN}_3 & \quad \text{CH}_3\text{CN, rt} & \quad \text{R} & \quad \text{Br} & \quad \text{R'} \\
\text{R} = \text{Aryl, H} & \\
\text{R}' = \text{Aryl, Alkyl, COR, COOR} &
\end{align*}
\]

Scheme 1

CHAPTER 3

An efficient protocol for stereoselective epoxidation of cinnamic esters using TsNBr₂

This chapter includes the synthesis of epoxide from cinnamic esters without any catalyst. The reaction was performed in CH₃CN–water (4:1) using N,N-dibromo-p-toluenesulfonamide (TsNBr₂) in alkaline conditions. This procedure can be utilized for stereoselective synthesis of epoxides from cinnamic esters in excellent yield in a shorter reaction time with exclusive formation of the trans-isomer. The method is further extended successfully for styrenes (Scheme 2).

\[
\begin{align*}
\text{Ar} & \quad \text{OR} \\
\text{O} & \quad \text{OR} \\
\text{TsNBr₂} & \quad \text{MeCN–H₂O(4:1)} \\
\text{K₂CO₃, rt} & \quad \text{Ar} & \quad \text{OR} \\
\end{align*}
\]

\(R = \text{Ar, H}\)
\(R' = \text{H, COOEt, COOMe}\)

Scheme 2

CHAPTER 4

Regio- and stereoselective synthesis of aminobromine from olefins using TsNBr₂ without any catalyst

A very rapid and efficient method is developed for the synthesis of vicinal aminobromine directly from olefin using N,N-dibromo-p-toluenesulfonamide (TsNBr₂) without any catalyst. This procedure is applicable to various olefins such as to give the corresponding 1,2-bromoamine in an excellent yield (Scheme 3).

\[
\begin{align*}
\text{R} & \quad \text{R'} \\
\text{TsNBr₂} & \quad \text{CH₂Cl₂, rt} \\
\end{align*}
\]

\(R = \text{Aryl, H}\)
\(R' = \text{Aryl, Alkyl, COR, COOR}\)

Scheme 3

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CHAPTER 5

A simple and efficient bromoformyloxylation reaction using TsNBr₂.

This chapter deals with synthesis of the vicinal bromoformyloxylation reaction using \( N,N\)-dibromo-\( p \)-toluene sulfonamide as halogen and \( N,N \)-dimethyl formamide as the nucleophilic source. The reaction is extremely fast giving the product instantaneously. It works with varieties of olefins with a very good yield (Scheme 4).

\[
\begin{align*}
R' & \text{O} \text{C} \text{H} \text{O} \text{Br} \\
\text{TsNBr}_2 & \text{DMF, rt} \\
R & = \text{Aryl, H} \\
R' & = \text{Aryl, Alkyl, COR, COOR}
\end{align*}
\]

Scheme 4

CHAPTER 6

A synthetic approach for the enantiopure bromohydrins using Evans chiral auxiliary as chiral precursor and TsNBr₂ as brominating agent

The uses of chiral auxiliaries in the synthesis of enantiomerically pure compounds have been found wide application for a variety of reactions over the last three decades. We have already developed a stereoselective bromohydroxylation method using TsNBr₂. In this chapter, we are disclosing our results for the synthesis of enantiopure bromohydrins using Evans chiral auxiliary (Scheme 5).

\[
\begin{align*}
\text{R'COOH} & \xrightarrow{(\text{COCl})_2} \text{R'COCl} \\
& \xrightarrow{\text{Ph, BuLi, THF}} \text{R'CONHCPh} \\
\text{R'CONHCPh} & \xrightarrow{\text{TsNBr}_2, \text{MeCN, H}_2\text{O (9:1)}} \text{R'CONHBr}
\end{align*}
\]

Scheme 5
CHAPTER 7

A rapid bromination of phenols using TsNBr$_2$ as brominating agent.

Bromination of phenols is one of the key reactions in their functionalization and in the synthesis of different derivatives. This chapter reports the bromination of phenol with $N,N$-dibromo-$p$-toluene sulfonamide that has been found to be very effective. The tribromo product of phenol was formed instantaneously with excellent yield in CH$_3$CN medium (Scheme 6).

$$\text{TsNBr}_2 \rightarrow \text{Br-TsNBr}_2$$

**Scheme 6**

CHAPTER 8

A facile noncatalytic pathway for the nitrene transfer process: expeditious access to aziridines

Nitrenes are among the most fundamental reactive intermediates in organic synthesis. A very common and widely utilized nitrene insertion reaction as a synthetic tool for achieving nitrogenous molecules is the synthesis of aziridines. In this chapter, we discuss a fast and efficient method for generation of sulfonyl nitrene from $N,N$-dibromo-$p$-toluenesulfonamide (TsNBr$_2$) in the presence of a base without any catalyst. This method was applied to produce aziridines from different kinds of olefins within a short time in high yields$^3$ (Scheme 7).

$$\text{R'-R} \xrightarrow{\text{TsNBr}_2 (1.2 \text{ equiv})} \text{R'-R} \xrightarrow{\text{K}_2\text{CO}_3 (2.5 \text{ equiv})} \text{NTs}$$

**Scheme 7**