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Short communication

A facile regio- and stereoselective synthesis of β-aminosulfides from aziridines using ammonium-12-molybdophosphate☆

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Abstract

An efficient regio- and stereoselective synthesis of β-aminosulfides has been achived by treatment of aziridines with thiols in the presence of ammonium-12-molybdophosphate (AMP) as a heterogeneous catalyst.

Keywords: Aziridine; β-Aminosulfide; Thiol; Ammonium-12-molybdophosphate; Heterogeneous catalyst

β-Aminosulfides are important intermediates for the synthesis of various bioactive compounds [1]. These compounds have previously been prepared by ring-opening of aziridines with thiols using protic and Lewis acids and bases [2]. However, many of the earlier methods are associated with different drawbacks, such as harsh reaction conditions, poor yields and requirement of excess thiols as well as catalysts. In continuation of our work [3] on the development of useful synthetic methodologies we report that ammonium-12-molybdophosphate (AMP), $(NH_4)_3[PMo_{12}O_{40}]$ [4] can efficiently be applied as a catalyst for cleavage of aziridines with thiols to form the corresponding β-aminosulfides at room temperature (Schemes 1 and 2).

A Series of β-aminosulfides was prepared from various *N*-tosyl-2-aryl (alkyl) aziridines and thiols (Table 1). Some bicyclic *N*-tosyl aziridines were also used. The products were formed in excellent yields within 2 h. The conversion of aziridines took place with high regio- and stereoselectivity. *N*-tosyl-2-aryl aziridines yielded products formed by cleavage at the benzylic position while *N*-tosyl-2-(alkyl) aziridines furnished products formed by opening at the terminal position. The cleavage of symmetrical bicyclic *N*-tosyl aziridines with thiols afforded *trans*-products. The structures and stereochemistry of the β-aminosulfides were established from their spectral (^{1}H NMR and MS) data.

In recent years, heteropoly acids and their salts have been applied in various chemical transformations due to their impressive catalytic activity and ability to carry out reactions in a clean manner [5]. The synthetic utility of these catalysts has not yet been fully explored. The present catalyst, AMP (the ammonium salt of a heteropoly acid), is highly effective for ring opening of aziridines with thiols at room temperature. The catalyst works under heterogeneous conditions and can easily be handled and separated from the reaction mixture by simple filtration. In absence of the catalyst, only trace amount of the products was obtained.

In conclusion, we have developed a mild and efficient method for preparation of β-aminosulfides by ring opening of aziridines with thiols at room temperature using AMP as a heterogeneous catalyst. The excellent yields and high regio- and stereoselectivity are advantages of the protocol. An important application of the catalyst is also discovered.

1. Experimental

1.1. General procedure

A mixture of *N*-tosyl aziridine (1 mmol), thiol (1.2 mmol) and AMP (10 mol%) was taken in MeCN (10 ml). The mixture was stirried at room temperature for 2 h when TLC indicated the completion of the reaction. Water–EtOAc (1:1) (10 ml) was added and the mixture was shaken and filtered. Organic portion was separated from the filtrate and concentrated. The

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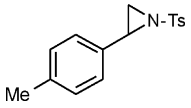
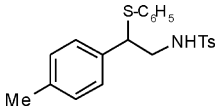
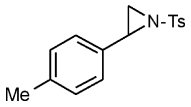
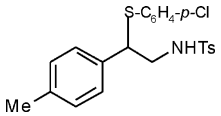
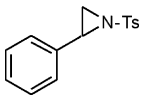
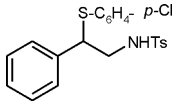
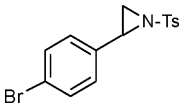
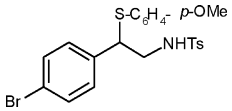
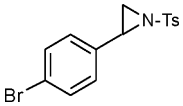
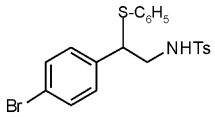
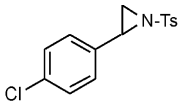
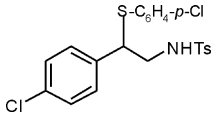
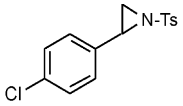
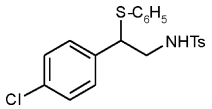
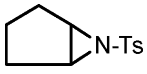
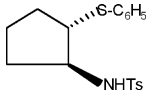
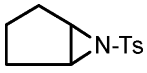
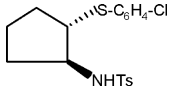
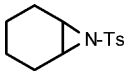
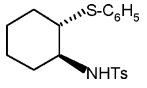
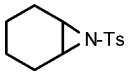
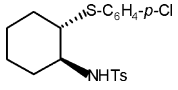
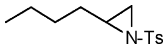
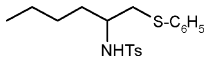
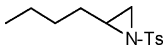
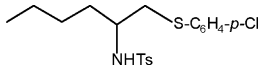
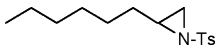
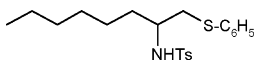
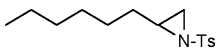
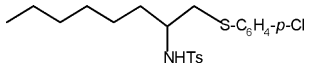
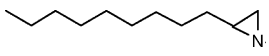
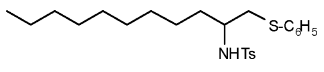
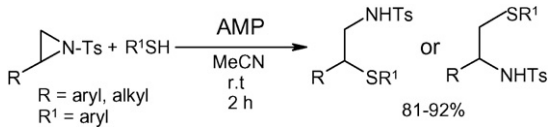
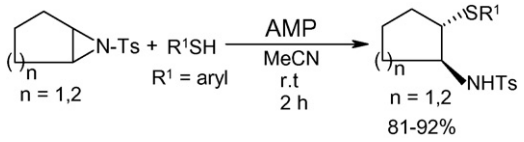
Table 1
Synthesis of β-aminosulfides from aziridines using ammonium-12-molybdophosphate

Entry	Aziridine **1**	Thiol **2**	Product **3**	Isolated yield (%)
a		$HS\text{-}C_6H_5$		92
b		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		88
c		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		85
d		$HS\text{-}C_6H_4\text{-}p\text{-}OMe$		87
e		$HS\text{-}C_6H_5$		83
f		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		85
g		$HS\text{-}C_6H_5$		87
h		$HS\text{-}C_6H_5$		83
i		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		81
j		$HS\text{-}C_6H_5$		85
k		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		83
l		$HS\text{-}C_6H_5$		87
m		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		84
n		$HS\text{-}C_6H_5$		85
o		$HS\text{-}C_6H_4\text{-}p\text{-}Cl$		83
p		$HS\text{-}C_6H_5$		81

The structures of the products were settled from their spectral (^{1}H NMR and MS) data.



Scheme 1.



Scheme 2.

residue was subjected to column chromatography (silica gel, hexane–EtOAc) to furnish β-aminosulfide.

The spectral data of some representative products are given below:

3b: ^{1}H NMR ($CDCl_3$, 200 MHz): δ 7.64 (2H, d, J = 8.0 Hz), 7.28 (2H, d, J = 8.0 Hz), 7.20–6.99 (8H, m), 4.55 (1H, t, J = 7.0 Hz), 4.11 (1H, t, J = 7.0 Hz), 3.25 (2H, t, J = 7.0 Hz), 2.44 (3H, s), 2.32 (3H, s); FABMS: m/z 434, 432 $[M+H]^+$.

3i: ^{1}H NMR ($CDCl_3$, 200 MHz): δ 7.60 (2H, d, J = 8.0 Hz), 7.29–7.14 (6H, m), 5.11 (1H, brs), 3.39 (1H, ddd, J = 10.5, 9.5, 4.0 Hz), 3.26 (1H, ddd, J = 10.0, 9.5, 4.0 Hz), 2.43 (3H, s), 2.20–2.02 (2H, m); 1.77–1.68 (2H, m), 1.60–1.45 (2H, m); FABMS: m/z 384, 382 $[M+H]^+$.

3l: ^{1}H NMR ($CDCl_3$, 200 MHz): δ 7.62 (2H, d, J = 8.0 Hz), 7.28–7.15 (7H, m), 4.68 (1H, d, J = 7.0 Hz), 3.30 (1H, m), 3.12 (1H, dd, J = 10.0, 4.0 Hz), 2.71 (1H, dd, J = 10.0, 7.0 Hz), 2.40 (3H, s), 1.46–1.08 (6H, m), 0.96 (3H, t, J = 7.0 Hz); FABMS: m/z 364 $[M+H]^+$.

Acknowledgements

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