Hydroxylamine-\(O\text{-sulfonic acid: As a dual role reagent}

Compiled by Meysam Yarie

Meysam Yarie was born in 1987 in Malayer, Hamedan, Iran. He received his B.Sc. in Applied Chemistry (2010) from Malek-Ashtar University of Technology and M.Sc. in Organic Chemistry (2012) from Kurdistan University under the supervision of Dr. Kamal Amani. He is currently working towards his Ph.D. under the supervision of Professor Mohammad Ali Zolfigol. His research interest is catalysis, including the synthesis, characterization and applications of homogeneous and heterogeneous catalysis in organic synthesis.

**Introduction**

Hydroxylamine-\(O\text{-sulfonic acid (HOSA) as a dual role reagent with formula } H_3NO_4S.\) It is a white solid with a melting point of 210°C. It is soluble in cold water, methanol, only slightly soluble in ethanol and insoluble in ether and Chloroform. HOSA is commercially available and has been synthesized by reacting hydroxylamine sulfate with 30% fuming \(H_2SO_4\) [1] or 60% oleum [2] at room temperature, or by heating a mixture of hydroxylamine sulfate and chlorosulfonic acid at 100°C for several hours [3]. It is hygroscopic and should be stored properly in tightly containers in refrigerator. HOSA has a wide variety of applications in organic syntheses such as amination at carbon [4], nitrogen [5] and sulfur [6], reduction [7], conversion of oximes to diazo compounds [8], conversion of methyl sulfones to sulfonamides [9], due to its ability to act both as a nucleophile and as an electrophile (Scheme 1).

**Abstracts**

(A) Ramachandran and co-workers reported regioselective hydroboration-amination of fluoro-substituted styrenes with \(BH_2\text{SMMe}_2\) and hydroxylamine-\(O\text{-sulfonic acid respectively. After hydroboration of } 4\text{-fluorostyrene, the reaction mixture was cooled to } 0\text{°C, quenched with methanol and aminated using hydroxylamine-}O\text{-sulfonic acid to obtain a } 72\% \text{ yield of essentially pure primary amine (ratio of } a:b= 97:3). \text{ Similarly, the hydroboration-amination of } 3\text{-trifluoromethyl styrene gave a } 65\% \text{ yield of primarily the primary amine (ratio of } a:b = 92:8) [10].
An alternative procedure for replacement of classical Hofmann, Lossen, and Curtis procedures, Wallace et al. [11] have reported an one-pot synthetic manner without use of hazardous azides for preparation of aromatic amines.

Kubel et al. reported the formation of the first twelve-membered ring periodic repetition of the -O-Te-N- sequence from the reaction between a β-(N,N-dimethylcarbamoyl-chalcogeno)-alkenyl ketone with hydroxylamine-O-sulfonic acid [12].

Diselenide treated with NaBH₄ and acetylenic ketone gives the corresponding carbamate, which, in the presence of HOSA, provides isoselenazole and its corresponding N-oxide [13] as a by-product. The actual pathway leading to the formation of N-oxide remains unclear.

The reaction of 6-chloropurine 1 with fourfold excess of hydroxylamine-O-sulfonic acid provided (Z)-1H-purin-6-ylideneaminooxysulfonic acid 2 which could be regarded as a secondary metabolite of ultimate mutagen 6-hydroxylaminopurine (6-HAP) [14].

HOSA has been used as a reagent for conversion of carbonyl functional group to diaziridine. The reaction is functional even for sterically hindered ketones [15].

Armstrong et al. have developed a novel route to oxaziirdine which is amenable to large-scale synthesis [16]. Amination of triphenylphosphine with hydroxylamine-O-sulfonic acid and subsequent N-protection via the acyl imidazolide 2 afforded iminophosphorane 3. Following aza-Wittig reaction with diethyl ketomalonate and oxidation of imine 4 with aqueous Oxone in CH₃CN/H₂O have been occurred.
HOSA has been used as nucleophile and reacted with activated heterocyclic halides by Saczewski and co-workers [17]. 2-chloro-4,5-dihydroimidazole reacts with a slight excess of HOSA in aqueous solution at room temperature, giving rise to the formation of 2-hydroxylamino-4,5-dihydro imidazolium-O-sulfonate. Treatment of 1 with a good range of aromatic aldehydes in aqueous NaOH solution gave the 3-substituted 6,7-dihydro-5H-imidazo[2,1-c][1,2,4]oxadiazoles.

References