SYNLETT Spotlight 291

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

Acetic Anhydride (Ac₂O)

Compiled by Lucas Villas Bôas Hoelz

Lucas V. B. Hoelz was born in Bom Jardim (Brazil), in 1980. He graduated in Pharmacy (2005) and received his M.Sc. degree in Organic Chemistry (2007) from Universidade Federal do Rio de Janeiro (UFRJ). Currently, he is working toward his D.Sc. in Chemistry at the same university under the supervision of Joaquim F. M. da Silva, Magaly G. Albuquerque and Ricardo B. de Alencastro. His research focus on the β_1 -adrenergic receptor, including the design and synthesis of new selective β -blockers.

LAB 609, Centro de Tecnologia, Bloco A, Instituto de Química, Universidade Federal do Rio de Janeiro, C.P. 68563, CEP 21945-970, Rio de Janeiro, Brazil
E-mail: lucashoelz@iq.ufrj.br

Introduction

Acetic anhydride (Ac₂O) is a very refractive liquid smelling strongly of acetic acid with a boiling point at 139 °C.¹ It is a cheap and commercialized reagent widely used in the synthesis of oxazolones,² thiohydantoins,³ thioacetates,⁴ enamides,⁵ geminal diacetates,⁶ thiadiazoles,⁷ as well as in the preparation of carbonyl compounds from imines.⁸ Further, it is used in acetylations,⁹ brominations,¹⁰ Grignard reactions,¹¹ and reductive acylations of nitropyrroles.¹²

Preparation

Ac₂O (**1**) was formerly produced starting from sodium acetate and acetyl chloride (**A**). However, nowadays it is usually prepared from acetic acid dehydration (**B**, Scheme 1).¹³

Scheme 1

Abstracts

(A) Sun and Cui described the synthesis of oxazolones from a mixture of aryl or heteroaryl aldehydes, hippuric acid (**2**) and anhydrous sodium acetate in Ac₂O under microwave irradiation. All reactions were carried out in a few seconds and provided good yields (49–56%).²

(B) According to Reyes and Burgess, the reaction of some amino acids (e.g., glycine, alanine, and phenylalanine) with Ac₂O and ammonium thiocyanate gave the 1-acetyl-2-thiohydantoins in good yields (51–71%), respectively.³

(C) Nasir Baig and co-workers reported a simple and efficient methodology to synthesize thioacetates from alkyl halides in good yields (80–97%). [BnEt₃N]₂MoS₄ and Ac₂O are key reagents in this multi-step tandem reaction process.⁴

(D) Benzylic and non-benzylic ketoximes can be successfully converted into enamides using a mixture of Ac₂O and Et₃P in toluene.⁵

(E) Geminal diacetates can be prepared from aliphatic and aromatic aldehydes in moderate to excellent yields (36–93%) by a simple treatment with Ac_2O in the presence of $\text{InCl}_3/\text{Al}_2\text{O}_3$.⁶

(F) Thiosemicarbazones react with Ac_2O under mild conditions to give thiadiazole compounds in moderate to high yields (40–95%).⁷

(G) The SDS (sodium dodecyl sulphate) surfactant mediated cleavage of imines to the corresponding carbonyls (aldehydes and ketones) and acetanilides can be achieved with Ac_2O in water in very good to excellent yields (85–91%).⁸

(H) Various alcohols and phenols can be acetylated under solvent-free conditions using Ac_2O as acylating agent and a catalytic amount of heterogeneous cobalt(II) Salen complex (catalyst A). The products were prepared under mild conditions, short reaction times, and in high yields (95–99%).⁹

(I) An efficient procedure for the monobromination of activated aromatic compounds can be achieved by treatment with KBr in Ac_2O followed by a dropwise addition of nitric acid in Ac_2O .¹⁰

(J) 3,5-Bis(trifluoromethyl)phenylmagnesium chloride reacts with Ac_2O to produce 3,5-bis(trifluoromethyl)acetophenone. The product is formed within one hour in high yields (86–87%).¹¹

(K) The reductive acylation of nitropyrroles using a mixture of Ac_2O , acetic acid, and indium powder provided pyrrolylamides in moderate to good yields (41–86%).¹²

References

- (1) *The Merck Index 14th Ed.*; O'Neil M. J., Heckelman P. E., Koch C. B., Roman K. J., Kenny C. M., D'Arecca M. R.; Merck Research Laboratories: New York, **2006**, 11.
- (2) Sun, Y.-F.; Cui, Y.-P. *Dyes Pigments* **2009**, *81*, 27.
- (3) Reyes, S.; Burgess, K. *J. Org. Chem.* **2006**, *71*, 2507.
- (4) Baig Nasir, R. B.; Sai Sudhir, V.; Chandrasekaran, S. *Synlett* **2008**, 2684.
- (5) Zhao, H.; Vandenbossche, C. P.; König, S. G.; Singh, S. P.; Bakale, R. P. *Org. Lett.* **2008**, *10*, 505.
- (6) Salavati-Niasari, M.; Hydarzadeh, S. *J. Mol. Catal. A: Chem.* **2005**, *237*, 259??.
- (7) Shih, M.-H.; Wu, C.-L. *Tetrahedron* **2005**, *61*, 10917.
- (8) Das Sharma, S.; Gogoi, P.; Baruah, M.; Konwar, D. *Synth. Commun.* **2007**, *37*, 2473.
- (9) Rajabi, F. *Tetrahedron Lett.* **2009**, *50*, 395.
- (10) Tsoukala, A.; Liguori, L.; Occhipinti, G.; Bjørsvik, H.-R. *Tetrahedron Lett.* **2009**, *50*, 831.
- (11) Leazer, J. L. Jr.; Cvetovich, R. *Org. Synth.* **2005**, *82*, 115.
- (12) Fu, L.; Gribble, G. W. *Synthesis* **2008**, 788.
- (13) *Faith, Keyes, and Clark's Industrial Chemicals 4th Ed.*; Lowenheim, F. A.; Moran, M. K.; Wiley-Interscience: New York, **1975**, 16.