

SYNLETT Spotlight 234

p-Nitrobenzenesulfonamide

Compiled by Agathe C. Mayer



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

Agathe C. Mayer was born in Vienna, Austria in 1979. She studied chemistry at the Universities of Heidelberg and Mainz, Germany and at the University of Massachusetts in Amherst, MA, USA. After completing her diploma thesis in 2005 under the supervision of Prof. Dr. H. Kunz at Mainz University, she joined the research group of Prof. Dr. C. Bolm at RWTH Aachen University to pursue a PhD. Her research is focused on the development of new methods for metal-catalyzed carbon–heteroatom bond-formation reactions.

Institut für Organische Chemie der RWTH Aachen, Landoltweg 1,
52056 Aachen, Germany
E-mail: agathe.mayer@oc.rwth-aachen.de

Introduction

p-Nitrobenzenesulfonamide (*p*-NsNH₂, nosyl amide, **1**) is a valuable reagent in organic synthesis. It can be prepared from the corresponding sulfonyl chloride by treatment with either ammonium carbonate¹ or ammonia.² Furthermore, **1** is commercially available.

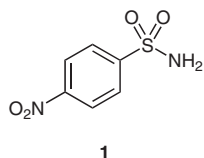
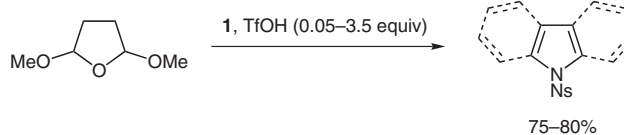


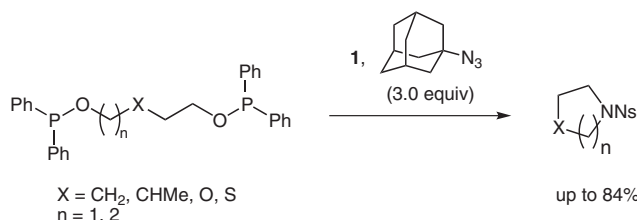
Figure 1

Abstracts

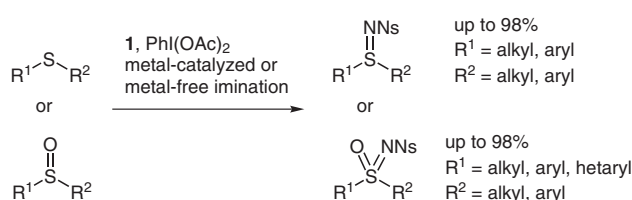
(A) *p*-Nitrobenzenesulfonamide (**1**) acts as a nitrogen source in the synthesis of heterocycles. Pyrroles, indoles, and carbazoles are accessible through successive annelation reactions with triflic acid.⁴ Török and co-workers found that the ratio of triflic acid to reagent determines the reaction outcome. Hence, *p*-Ns pyrrole is formed with 0.05 equiv of triflic acid whereas the indole derivative is formed with an equimolar amount of the acid. An excess of triflic acid (3.5 equiv) leads to the carbazole product.



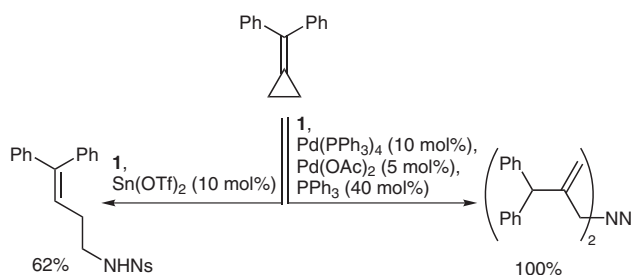
(B) Furthermore, **1** is a useful reagent in the assembly of non-aromatic heterocycles. Mukaiyama et al.⁵ described an efficient method for the preparation of pyrrolidines, piperidines, morpholines, and thiomorpholines. The products were formed in moderate to good yields.



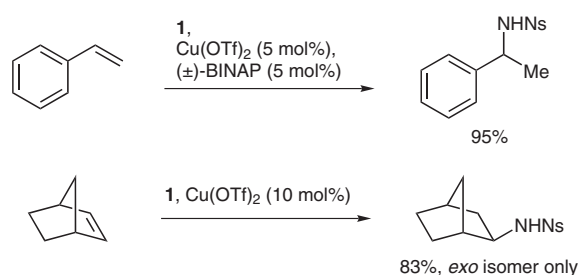
(C) Bolm and co-workers described efficient imination reactions of sulfides and sulfoxides using **1** as a nitrogen source, furnishing synthetically valuable sulfinimines and sulfoximines, respectively, in high yields. Both metal-catalyzed (Rh, Ag, Cu, Fe)^{6a-d} and metal-free variants of the reaction have been reported.^{6e}



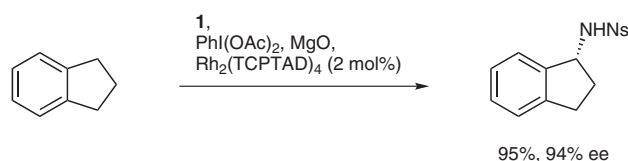
(D) Metal-catalyzed ring-opening reactions of methylene cyclopropanes with **1** were reported by Shi and co-workers. Depending on the metal catalyst used, the products of these transformations are either homoallylic^{10a} or allylic^{10b} sulfonamides. The latter can be deprotected to the corresponding allylic amines, which constitute interesting synthetic intermediates.



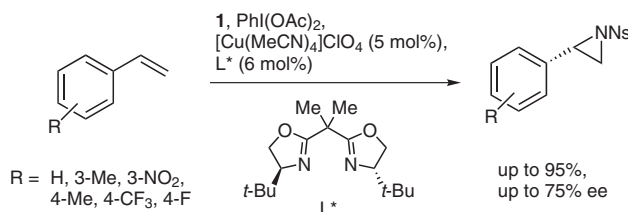
(E) Taylor et al. reported a copper-catalyzed intermolecular hydroamination of olefins with sulfonamide **1**.⁷ The hydroamination of styrene furnished 1-phenethylsulfonamide in excellent yield. The reaction was found to be greatly enhanced by the addition of BINAP as a ligand as it was assumed that the ligand lowered the energy barrier of the process. The protocol was also found suitable for other alkenes such as norbornene. As with the styrenic substrates, the corresponding amine was formed in good yield. Interestingly, formation of the *exo* isomer was exclusively observed in this case.



(F) Reddy and Davies achieved C–H activation reactions of alkanes with **1** and an adamantane-derived rhodium catalyst [Rh₂(TCPTAD)₄]. Both excellent yields and enantioselectivities in the C–H amination of indene were reported.⁸



(G) A copper-catalyzed one-pot procedure for aziridinations was recently reported by Kwong et al.¹¹ They used either **1** in combination with an oxidant [PhI(OAc)₂] or the corresponding preformed iminoiodinane [synthesized from **1** and PhI(OAc)₂] as nitrene source for the aziridination of styrene and derivatives thereof. In combination with Evans' oxazoline ligand, very high yields and good enantioselectivities could be obtained.



References

- Blanksma, J. *Recl. Trav. Chim. Pays Bas* **1901**, *20*, 121.
- Ruostesuo, P.; Häkkinen, A.-M.; Mattila, T. *Magn. Reson. Chem.* **1987**, *25*, 189.
- (a) Fukuyama, T.; Jow, C.-K.; Cheung, M. *Tetrahedron Lett.* **1995**, *36*, 6373. (b) Greene, T. W.; Wuts, T. G. M. *Protective Groups in Organic Synthesis*, 3rd ed.; John Wiley & Sons: New York, **1999**, 609.
- Abid, M.; Teixeira, L.; Török, B. *Tetrahedron Lett.* **2007**, *48*, 4047.
- Mukaiyama, T.; Kuroda, K.; Aoki, H. *Chem. Lett.* **2005**, *34*, 1644.
- (a) Okamura, H.; Bolm, C. *Org. Lett.* **2004**, *6*, 1305. (b) Cho, G. Y.; Bolm, C. *Org. Lett.* **2005**, *7*, 4983. (c) García Mancheño, O.; Bolm, C. *Org. Lett.* **2006**, *8*, 2349. (d) García Mancheño, O.; Bolm, C. *Chem. Eur. J.* **2007**, *13*, 6674. (e) Cho, G. Y.; Bolm, C. *Tetrahedron Lett.* **2005**, *46*, 8007.
- Taylor, J. G.; Whittall, N.; Hii, K. K. *Org. Lett.* **2006**, *8*, 3561.
- Reddy, R. P.; Davies, H. M. L. *Org. Lett.* **2006**, *8*, 5013.
- Li, Z.; Capretto, D. A.; Rahaman, R.; He, C. *Angew. Chem. Int. Ed.* **2007**, *46*, 5184; *Angew. Chem.* **2007**, *119*, 5276.
- (a) Chen, Y.; Shi, M. *J. Org. Chem.* **2004**, *69*, 426. (b) Shi, M.; Chen, Y.; Xu, B. *Org. Lett.* **2003**, *5*, 1225.
- Kwong, H.-L.; Liu, D.; Chan, K.-Y.; Lee, C.-S.; Huang, K.-H.; Che, C.-M. *Tetrahedron Lett.* **2004**, *45*, 3965.
- Li, Z.; Ding, X.; He, C. *J. Org. Chem.* **2006**, *71*, 5876.
- Raheem, I. T.; Jacobsen, E. N. *Adv. Synth. Catal.* **2005**, *347*, 1701.
- Wu, Y.; Zhang, Y.; Yu, M.; Zhao, G.; Wang, S. *Org. Lett.* **2006**, *8*, 4417.