

Zinc-Mediated Synthesis of Diaryl Selenides from Diaryl Diselenides and Diaryliodonium Salts in Aqueous Media

Barahman Movassagh^{a,b} and Azadeh Fazeli^a

^a Department of Chemistry, K. N. Toosi University of Technology, P.O. Box 16315-1618, Tehran, Iran

^b Kermanshah Oil Refining Company, Kermanshah, Iran

Reprint requests to Prof. B. Movassagh. E-mail: bmovass1178@yahoo.com

Z. Naturforsch. **61b**, 194 – 196 (2006); received November 17, 2005

An efficient synthetic method has been developed for the preparation of symmetrical and unsymmetrical diaryl selenides through a one-pot reaction of diaryl diselenides and diaryliodonium salts in the presence of Zn/AlCl₃ system in aqueous media.

Key words: Diaryl Selenides, Diselenides, Diaryliodonium Salts, Zn/AlCl₃

Introduction

The chemistry of organoselenium compounds has been growing in recent years, because of the many synthetic applications of these compounds [1]. The synthesis of diaryl selenides has attracted considerable attention due to the fact that these compounds have widespread applications. Diaryl selenides, containing amino groups, have useful antioxidative properties [2], and some biologically active molecules include diarylselenium moiety [3]. Among the useful and general methods for the preparation of symmetrical and unsymmetrical diaryl selenides, we can cite those involving the treatment of arenediazonium salts with sodium selenide [4] and with sodium benzeneselenolate [5], the reaction of electrophilic selenium species such as diselenides and selenocyanates with Grignard reagents and aryllithiums [6], the arylation of sodium benzeneselenolate with an aryl halide catalyzed by nickel (II) complex [7], photochemical reaction of simple haloarenes with sodium areneselenolate [8], the reaction of diaryl diselenides with activated halides in the presence of aminoiminomethanesulfonic acid [9], copper-catalyzed reaction of aryl iodide and diphenyl diselenide using magnesium metal [10], palladium-catalyzed reactions of phenyltributylstannyl selenide (PhSeSnBu₃) with aryl halides and triflates [11]. However, some of these methods suffer from disadvantages such as the use of toxic, hazardous, expensive or less easily available reagents, harsh reaction conditions or lower yields. In two recent reports, areneselenyl magnesium bromide [12] and di-

aryl diselenide [13] reacted with diaryliodonium salts to give the corresponding diaryl selenides. However, these methods were either performed under anhydrous condition and nitrogen atmosphere [12] or used unavailable titanocene hydride (Cp₂TiH) and low temperature [13]. Hence, the development of a one-step synthetic method using stable reagents under atmospheric conditions is in demand.

Results and Discussion

In the last decade, much attention has been paid to organometallic reactions in aqueous media [14]. Recently, transition metal selenolates or complexes have been widely used in synthesis of organoselenium compounds [15], but reports exploring zinc selenolates are rare [16]. In the present paper we propose a convenient one-pot method for the synthesis of diaryl selenides via reaction of diaryliodonium salts and diselenides promoted by Zn/AlCl₃ system. It has been reported earlier [16] that zinc arylselenolates can be easily generated from diaryl diselenides in the presence of Zn/AlCl₃ system. Simple stirring of diselenide **1** with metallic zinc dust in the presence of anhydrous aluminum chloride in CH₃CN-H₂O mixed solvent at 83 °C produced the zinc selenolate **2**. This was followed by addition of diaryliodonium salt which gave, after work-up, the desired selenide (Scheme 1) in 52–82% yield as shown in Table 1. These diaryliodonium salts are electrophilic arylating agents and are more susceptible to nucleophilic displacement, since their positive charges should facilitate polar fission of the bonds to the aro-

- [11] a) I. P. Beletskaya, A. S. Sigeev, A. S. Peregudov, P. V. Petrovskii, *J. Organomet. Chem.* **605**, 96 (2000);
b) Y. Nashiyama, K. Tokunaga, N. Sonoda, *Org. Lett.* **1**, 1725 (1999).
- [12] L. Wang, Z.-C. Chen, Q.-G. Zheng, *Chinese J. Chem.* **20**, 1457 (2002).
- [13] X. Huang, L.-L. Wu, X.-H. Xu, *Synth. Commun.* **31**, 1871 (2001).
- [14] a) A. Lubineau, J. Auge, Y. Quéneau, *Synthesis* 741 (1994); b) C. J. Li, *Chem. Rev.* **93**, 2023 (1993).
- [15] a) A. Osuka, N. Ohmasa, H. Suzuki, *Synthesis* 857 (1982); b) P. Meunier, B. Gaothéron, A. Mazouz, *J. Chem. Soc., Chem. Commun.* 424 (1986); c) W. Bao, Y. Zhang, *Synth. Commun.* **25**, 1825 (1995).
- [16] a) B. Movassagh, M. Shamsipoor, *Synlett* 121 (2005);
b) B. Movassagh, F. Mirshojaei, *Monatsh. Chem.* **134**, 831 (2003); c) B. Movassagh, M. Shamsipoor, M. Joshaghani, *J. Chem. Res. (S)* 148 (2004);
d) X. Huang, X.-H. Xu, *Synth. Commun.* **28**, 807 (1998).
- [17] D. F. Banks, *Chem. Rev.* **66**, 243 (1966).
- [18] a) F. M. Beringer, R. A. Falk, M. Karniol, I. Lillien, G. Masullo, M. Mausner, E. Sommer, *J. Am. Chem. Soc.* **81**, 342 (1959); b) F. M. Beringer, M. Drexler, E. M. Gindler, C. C. Lumpkin, *J. Am. Chem. Soc.* **75**, 2705 (1953); c) F. M. Beringer, P. S. Forgione, *Tetrahedron* **19**, 739 (1963).