Palladium-Catalyzed Direct Arylation of Selenophene

Daniel S. Rampon (PG),[1,2] Ludger A. Wessjohann (PQ),[2] Paulo H. Schneider (PQ)[1]*

1. Instituto de Química, Departamento de Química Orgânica, Universidade Federal do Rio Grande do Sul, UFRGS, 91501-970, Porto Alegre-RS, Brazil; 2. Department of Bioorganic Chemistry, Leibniz Institute of Plant Biochemistry, Weinberg 3, 06120 Halle (Saale), Germany

**e-mail corresponding author paulos@iq.ufrgs.br*

Keywords: Selenophene, direct arylation, palladium.

INTRODUCTION

The palladium-catalyzed direct arylation of several (hetero)arenes via direct C−H bond activation using aryl halides has brought significative advances on the synthetic area in recent years.[1] Such couplings are very attractive to replace classical palladium catalyzed type couplings, once they do not require the preliminary synthesis of one or two organometallic derivatives.[2] Therefore, these reactions are atom-economical and produce less waste. Up to now, to promote a cross-coupling reaction with the selenophene ring (**1**), a previous activation, either as a halide or as an organometallic (B, Mg, Sn and Zn) is required.[3] This fact and our continuous interest in the synthesis of organoselenium compounds, prompted us to explore a new approach on the palladium-catalyzed direct arylation of selenophene (figure 1).

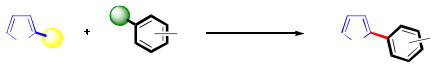
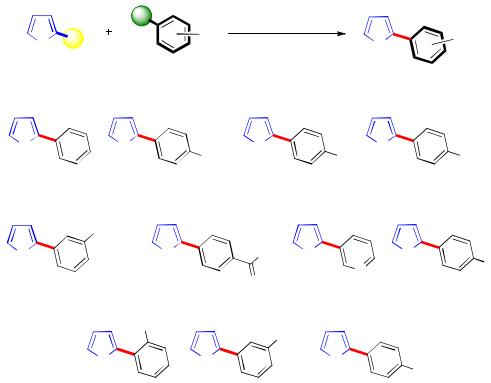


Figure 1. Palladium-Catalyzed Direct Arylation of Selenophene.

RESULTS AND DISCUSSION

The suitable reaction conditions were developed with commercially available selenophene (**1**) and bromobenzene (**2a**). The first attempt was performed under Fagnou direct arylation conditions.[4] However, only poor yields (18%) of product **3a** were obtained. This prompted us to reevaluate the process in order to determine if any benefits would result from the appropriate choice of ligand, base or additive, considering also the crucial role of pivalate as proton shuttle in regioselective direct arylations.[5] We found out that the combination of PPh_3−$Pd(OAc)_2$ with PivOH−K_2CO_3 afforded good yield of 2-phenylselenophene (**3a**) (82%). To explore the scope and limitation of this method, the coupling reactions between a variety of aryl halides (**2a**-**s**) and selenophene (**1**) were investigated under the improved conditions (scheme 1). In each case, the reaction proceeded regioselectively providing the 2-arylation product in moderate to excellent yield (30-93%).



Scheme 1. Scope of the Selenophene Direct Arylation (**1**).

The 2-arylated substrates can undergo an additional regioselective direct arylation event furnishing symmetrical or unsymmetrical 2,5-diaryl selenophenes in good yield, or generate effectively in one step symmetrical 2,5-diarylselenophenes with more than twofold excess of aryl iodide equivalents. Competition experiments and the role of the acid additive are in agreement with a concerted metalation deprotonation (CMD) pathway.[5,6]

CONCLUSION

In conclusion, an efficient palladium-catalyzed direct and regioselective arylation method for selenophene at the C-2 and subsequently at the C-5-position has been developed. The versatile method allows the synthesis of a large variety of 2-aryl or symmetric 2,5-diaryl selenophenes in one step with good to excellent yields.

ACKNOWLEDGEMENTS

CAPES, CNPq, INCT-Catalysis, FAPERGS and UFRGS.

REFERENCES

[1] Yu, J. Q.; et al. *Angew. Chem. Int. Ed.* **2009**, *48*, 5094.
[2] Chen, D. Y.-K.; Youn, S. W. *Chem. Eur. J.* **2012**, *18*, 9452.
[3] Rhoden, C. R. B.; Zeni, G. *Org. Biomol. Chem.* **2011**, *9*, 1301.
[4] Fagnou, K.; et al. *J. Org. Chem.* **2009**, *74*, 1826.
[5] Ackermann, L. *Chem. Rev.* **2011**, *111*, 1315.
[6] Yu, J. Q.; Shi, Z. *Topics in Current Chemistry: C-H Activation*. Springer-Verlag Berlin, **2010**.