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Convenient one-pot synthesis of *trans*-1,2-diaryloxiranes from the direct coupling of benzyl halides

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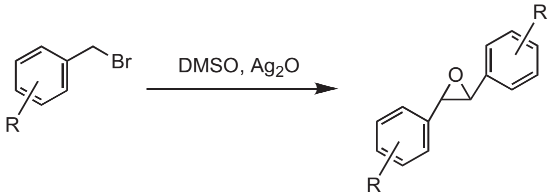
ABSTRACT

trans-1,2-Diaryloxiranes were conveniently prepared in an one-pot reaction by the direct coupling of benzyl halides in the presence of silver oxide and DMSO under mild conditions.

1. Introduction

Epoxides or oxiranes are an important class of chemicals and their reactions and synthesis have been extensively discussed.[1–3] In this Letter, we present an unusual direct coupling reaction of benzyl halides to form symmetrically substituted trans-1,2-diaryloxiranes in the presence of silver oxide (Ag_2O) and DMSO under mild conditions.



Previously we reported a convenient method for the conversion of benzyl halides into aldehydes and ketones in the presence of Ag_2O and pyridine N-oxide.[4] When DMSO was employed instead of pyridine N-oxide as the source of oxygen, it was noted that the reaction with benzyl bromide gave a mixture of products.[4] An epoxide, *trans*-stilbene oxide, was isolated from the product mixture. Further experiments with DMSO as the solvent have led to the development of the current method. The overall reaction involves the unusual coupling of the benzylic carbon to form the *trans*-1,2-diaryloxirane as the main product.

The reactions were carried out in DMSO. One equivalent of silver oxide was utilized to facilitate the reaction. Silver oxide presumably assists the heterolysis of the carbon–halogen bond and also functions as a base. The reaction mechanism is yet to be illustrated and awaits further investigation. However, a small amount of cross-coupling product was isolated when *p*-chlorobenzaldehyde was added to the reaction of benzyl bromide with silver oxide and DMSO, indicating possible involvement of aldehyde as a reaction intermediate. The reaction does not work with benzyl bromide derivatives with strong electron-withdrawing groups such as nitro or cyano groups.

The reactions were conveniently carried out by stirring the reaction mixture overnight at room temperature. Upon completion of the reaction, the resulting mixture was centrifuged, decanted, and concentrated to give the epoxides as reasonably pure crude products. The epoxides were further purified through flash chromatography using hexane (or a hexane/methylene chloride mixture) as solvent. As shown in Table 1, the epoxides were obtained in moderate yield. All epoxides were identified as the trans-isomer by their NMR spectra.[5]

The above results have demonstrated that benzyl bromide derivatives can be directly coupled to form *trans*-epoxide. The one-pot reaction is conveniently carried out and can be of interest if symmetrically substituted 1,2-diaryloxiranes are desired.

2. Experimental details

All reagents were obtained from commercial sources and used without further purification.

2.1. Typical experimental procedure

Silver oxide (0.68 g, 2.9 mmol) was added to a solution of benzyl bromide (0.50 g, 2.9 mmol) in anhydrous DMSO (5 mL) in a

Table 1
Coupling of benzyl bromide derivatives to epoxides

Entry	Benzyl bromide derivatives	Yield (isolated) (%)
1	R = H	48
2	R = *p*-Br	43
3	R = *o*-Cl	48
7	R = 2-Cl-4-F	52
4	R = *p*-CO_2CH_3	58
5	R = *m*-CO_2CH_3	57
6	R = *p*-CF_3	48

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round-bottommed flask. The resulting mixture was stirred overnight under nitrogen. The reaction mixture was centrifuged, decanted, and concentrated to give the crude product. The product was purified by flash chromatography using hexane as the solvent (0.14 g, 48%). The product was identified to be *trans*-stilbene oxide by comparison of its NMR spectrum and melting point to that of an authentic sample.[5]

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