CHEMISTRY LETTERS, pp. 1531-1532, 1993.

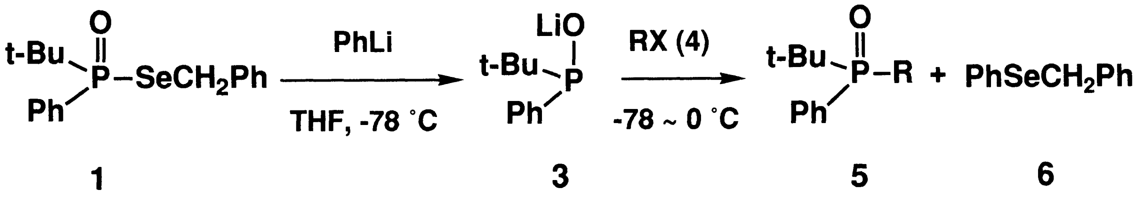
Synthesis of Optically Active Phosphorus Compounds via Metal Phosphinites Generated by Reaction of Optically Active Selenophosphinates with Phenyllithium

Takayuki KAWASHIMA,* Hiroki IWANAGA, and Renji OKAZAKI*
Department of Chemistry, Faculty of Science, The University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113

Sequential treatment of optically active Se-benzyl t-butylphenylselenophosphinate with PhLi and then with electrophiles such as alkyl halides and elemental selenium gave optically active phosphorus compounds in good chemical and optical yields with a retention of configuration at phosphorus atom, together with benzyl phenyl selenide.

Although nucleophilic substitution reactions at a phosphorus atom have been known as one of the excellent methods for the synthesis of optically active phosphorus compounds, its stereochemistry and stereospecificity are highly dependent on the life time of a pentacovalent intermediate.1) On the other hand much attention has been paid to optically active secondary phosphine oxides, sulfides and boranes, because of their easy conversion to optically active phosphorus compounds.2) In the course of our studies on the reaction of thio- and dithiophosphinates with nucleophiles,3) we reported the synthesis of optically active phosphine sulfides via the corresponding thiophosphinite.4) We now report a new synthetic method for optically active phosphorus compounds by chemoselective reaction of optically active selenophosphinates with phenyllithium, followed by treatment with electrophiles.

Sequential treatment of optically active Se-benzyl t-butylphenylselenophosphinate (**1**) (0.29-1.27 mmol),5) which was prepared by Se-benzylation of readily resolved selenophosphinic acid **2**,6) with phenyllithium (1.1-1.2 equiv) at -78 °C in tetrahydrofuran (THF) (8-15 ml) and then with alkyl halides **4** (1.2-1.5 equiv) at -78 - 0 °C gave the corresponding optically active phosphine oxides **5**7) in good chemical and optical yields along with benzyl phenyl selenide (**6**) (Table 1).



Phosphine oxides **5a** and **5c** were found optically pure by Harger's method.8) Quantitative formation of **6** indicates that phenyllithium exclusively attacked on the selenium atom to give phosphinite **3** in contrast with the reaction of thiol esters of thiophosphinate with nucleophiles.3a,b) Such a high chemoselectivity is most likely due to faster Li/Se exchange compared with Li/S exchange.9)

Table 1. Yields and Specific Rotations of Phosphine Oxides **5**

	1	R	X	Yield[a]/%	Specific rotation
a:	(-)	Me	I	91	$[\alpha]_D^{23}$ +20.9° (c 0.297, MeOH)[b]
b:	(-)	Et	I	75	$[\alpha]_D^{27}$ -20.3° (c 1.04, MeOH)
c:	(-)	$PhCH_2$	Br	72	$[\alpha]_D^{22}$ -115.9° (c 0.773, MeOH)
d:	(+)	*n*-Bu	I	56	$[\alpha]_D^{17}$ +14.2° (c 0.756, MeOH)
e:	(+)	$I(CH_2)_3$	I	76	$[\alpha]_D^{22}$ +42.7° (c 0.808, MeOH)[c]

a) Isolated yields based on **1**. b) Optical purity was 92%.[10] c) Product was **5** (R=*t*-BuPhP(O)$(CH_2)_3$).

The reaction with 0.5 equiv of 1,3-diiodopropane gave a single diastereomer (+)-**5e**, while use of racemic **1** instead of (-) -**1** afforded a 1:1mixture of *meso*- and *dl*-diastereomers (δ_P 50.1 and 51.5), showing that no racemization occurred in spite of two times increase in its chance.

A similar reaction using (-)-**1** ($[\alpha]_D^{31}$ -9.84° (c 0.838, MeOH)), followed by treatment with elemental selenium and then with benzyl bromide gave (-)-**1** (61%) with almost the same optical rotation ($[\alpha]_D^{31}$ -9.83° (c 0.290, MeOH)) as that of the starting **1**, indicating that all steps proceeded with a retention of configuration at a phosphorus atom and without any racemization.

References

1) J. Emsley and D. Hall, "The Chemistry of Phosphorus," Harper & Row Ltd, London (1976), Chap. 8, pp. 319-325; R. A. Lewis and K. Mislow, *J. Am. Chem. Soc.*, **91**, 7009 (1969).

2) For oxides, see: J. Michaski and Z. Skrzypczynski, *J. Organomet. Chem.*, **97**, C31 (1975); Y. Koide, A. Sakamoto, and T. Imamoto, *Tetrahedron Lett.*, **32**, 3375 (1991). For sulfides, see: Z. Skrzypczynski and J. Michalski, *J. Org. Chem.*, **53**, 4549 (1988). For boranes, see: T. Oshiki, T. Hikosaka, and T. Imamoto, *Tetrahedron Lett.*, **32**, 3371 (1991).

3) a) K. Goda, R. Okazaki, K.-y. Akiba, and N. Inamoto, *Tetrahedron Lett.*, **1976**, 181; b) K. Goda, R. Okazaki, K.-y. Akiba, and N. Inamoto, *Bull. Chem. Soc. Jpn.*, **51**, 260 (1978); c) K. Goda and N. Inamoto, *Chem. Lett.*, **1975**, 1009.

4) T. Kawashima, S. Kojima, and N. Inamoto, *Chem. Lett.*, **1989**, 849.

5) (-)-**1**: colorless viscous oil; HRMS (70 eV): Found: *m/z* 352.0487. Calcd for $C_{17}H_{21}OP^{80}Se$: M, 352.0495. ^1H NMR ($CDCl_3$): δ=1.17 (9H, d, J_{HP}=17.8 Hz, $C(C\underline{H}_3)_3$), 3.70-4.30 (2H, m, $SeC\underline{H}_2$), 7.13 (5H, br s, $CH_2C_6\underline{H}_5$), 7.34-7.59 (3H, m, *m,p*-H of PPh), and 7.68-8.08 (2H, m, *o*-H of PPh). ^{31}P NMR ($CDCl_3$): δ=67.6; $[\alpha]_D^{31}$ -9.84° (c 0.838, MeOH). Satisfactory ^{13}C NMR data were obtained.

6) B. Krawiecka, Z. Skrzypczynski, and J. Michalski, *Phosphorus*, **3**, 177 (1973). Optically pure (-)-**2** ($[\alpha]_D^{20}$ -37.8° (c 0.56, MeOH)) and (+)-**2** ($[\alpha]_D^{30}$ +36.5° (c 0.767, MeOH)) were obtained via two times recrystallization of their (+)- and (-)-$PhCHMeNH_2$ salts, respectively.

7) Physical and spectral data of (+)-**5e** are shown as a typical example. (+)-**5e**: colorless crystals; mp 170.3-174.0 °C. HRMS (70 eV): Found: *m/z* 404.2036. Calcd for $C_{23}H_{30}O_2P_2$: M, 404.2034. ^1H NMR ($CDCl_3$): δ=1.09 (18H, d, J_{HP}=14.5 Hz, $2xC(C\underline{H}_3)_3$), 1.44-2.66 (6H, m, $-(C\underline{H}_2)_3-$), and 7.17-7.76 (10H, m, 2xPh). ^{31}P NMR ($CDCl_3$): δ=51.5. Satisfactory ^{13}C NMR data were obtained.

8) M. J. P. Harger, *J. Chem. Soc., Perkin Trans. 2*, **1980**, 1505. The optical purities of **5b** and **5d** have not been determined yet, but they are reasonably considered to be comparable to those of **5a** and **5c**.

9) H. J. Reich, D. P. Green, N. H. Phillips, J. P. Borst, and I. L. Reich, *Phosphorus, Sulfur and Silicon*, **67**, 83 (1992).

10) Highest optical rotation was reported to be $[\alpha]_D^{20}$ +28.1° (c 2.4, MeOH): T. Imamoto, K. Sato, and C. R. Johnson, *Tetrahedron Lett.*, **26**, 783 (1985).

(Received May 21, 1993)