

SHORT  
COMMUNICATIONS

## First Example of Aromatic Electrophilic Substitution Using Selenium(II) Chloride

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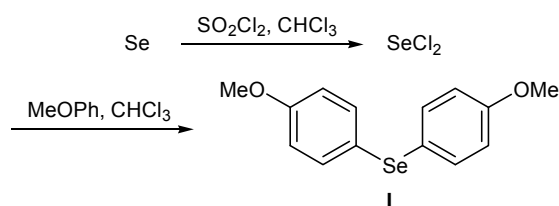
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Selenium dichloride is a promising reagent for organic synthesis. However, prior to our studies [1, 2], it was not used for the preparation of organoselenium compounds. It is known that selenium dichloride in solution exists in equilibrium with selenium tetrachloride and  $\text{Se}_2\text{Cl}_2$  [3]. No examples of aromatic electrophilic substitution with participation of selenium dihalides have been reported so far.

While continuing our systematic studies on reactions of selenium dihalides [1, 2, 4–10], we examined the reaction of selenium dichloride with methoxybenzene. The reaction occurred as aromatic replacement of hydrogen by the electrophile  $\text{Se}^{2+}$  and afforded bis(4-methoxyphenyl) selenide (**I**) in high yield (91%).



The reaction was carried out by heating the reactants in chloroform under reflux. The process was highly regioselective: electrophilic substitution involved exclusively the *para* position in methoxybenzene. This is the first example of aromatic electrophilic substitution with selenium dihalide. Selenium dichloride was prepared *in situ* by treatment of selenium with sulfuryl chloride.

Compound **I** was synthesized previously in 88% yield by reduction with zinc dust of bis(4-methoxyphenyl)selenium dichloride. The latter was prepared in turn from methoxybenzene and  $\text{SeOCl}_2$  (yield 75%) [11, 12]. The structure of compound **I** was confirmed by elemental analysis, whereas its spectral parameters were not given [11].

Thus selenium dichloride may be used as source of electrophilic  $\text{Se}^{2+}$  species in aromatic electrophilic substitution reactions. The possibility of using selenium dihalides for performing analogous reactions with other aromatic systems is now under study.

**Bis(4-methoxyphenyl) selenide (I)**, mp 54–55°C; published data [11]: mp 54°C.  $^1\text{H}$  NMR spectrum,  $\delta$ , ppm: 7.28 d (4H, CH,  $J = 7.4$  Hz), 6.69 d (4H, CH,  $J = 7.4$  Hz), 3.72 s (6H,  $\text{CH}_3\text{O}$ ).  $^{13}\text{C}$  NMR spectrum,  $\delta_{\text{C}}$ , ppm: 158.85 ( $\text{C}^4$ ), 135.24 ( $\text{C}^2$ ), 122.04 ( $\text{C}^1$ ), 114.53 ( $\text{C}^3$ ), 54.49 ( $\text{CH}_3\text{O}$ ). Mass spectrum,  $m/z$  ( $I_{\text{rel}}$ , %): 294 [ $M$ ] $^+$  (75), 214 (100), 199 (96), 187 (14), 171 (28), 144 (12), 128 (25), 107 (77), 92 (13), 77 (14), 63 (47), 39 (18).

The  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra were recorded on a Bruker DPX-400 spectrometer at 400.13 and 100.61 MHz, respectively, from a solution in carbon tetrachloride; the chemical shifts were determined relative to hexamethyldisiloxane. The mass spectrum (electron impact, 70 eV) was obtained on a Shimadzu GCMS-QP5050A instrument.

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