

Reaction of silylpentacarbonylmanganese with hydride-transfer reagents: reduction of carbonyl ligands accompanied with Si–C and C–C coupling

Rie Shiozawa, Hiromi Tobita *, Hiroshi Ogino *

Department of Chemistry, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan

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Abstract

Treatment of $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with an excess of LiAlH_4 , NaBH_4 , or $\text{NaBH}_3(\text{CN})$ in THF at room temperature gave hydrosilane $\text{H-SiTol}_2\text{H}$ in high yield together with $\text{Mn}_2(\text{CO})_{10}$. No reduction of CO ligands was observed. On the other hand, treatment of **2** with an excess of Red-Al (= $\text{Na}[(\text{CH}_3\text{OCH}_2\text{CH}_2\text{O})_2\text{AlH}_2]$) in toluene and subsequent addition of aqueous acidic solution afforded alkylsilanols $(\text{CH}_3)_3\text{SiTol}_2(\text{OH})$ and $(\text{C}_2\text{H}_5)_3\text{SiTol}_2(\text{OH})$. Treatment of the reaction mixture of **2** and Red-Al with LiAlH_4 in diethyl ether instead of hydrolysis gave alkylhydrosilanes $(\text{CH}_3)_3\text{SiTol}_2\text{H}$ and $(\text{C}_2\text{H}_5)_3\text{SiTol}_2\text{H}$. The methyl and ethyl groups on silicon originate from the CO ligands in **2**. These products clearly demonstrate that not only the Si–C coupling, but also C–C coupling occurs efficiently in this reaction. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Silyl complexes; Carbonyl complexes; Manganese complexes; Si–C coupling; C–C coupling; Reduction

1. Introduction

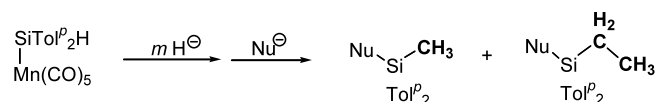
Reactions of hydride-transfer reagents with transition metal carbonyl complexes have attracted much attention in relation to the Fischer–Tropsch reaction. Although numerous reactions of this type have been reported [1–5], there are few examples in which a carbonyl ligand is not only reduced, but also coupled with another ligand [6,7]. Recently we reported a novel reaction of silyl(carbonyl)iron complexes $\text{CpFe}(\text{CO})_2\text{-SiR}_3$ (**1**) ($\text{Cp} = \eta^5\text{-C}_5\text{H}_5$, R = aryl, alkyl, H) with LiAlH_4 that resulted in Si–C coupling to give methylsilanes $(\text{CH}_3)_3\text{SiR}_3$ as a major product in moderate to high yield [8]. The labeling experiments using LiAlD_4 and $\text{CpFe}({}^{13}\text{CO})_2\text{SiTol}_2\text{R}'$ ($\text{R}' = \text{H}$, Me, $\text{Tol}^p = p\text{-CH}_3\text{C}_6\text{H}_4$) proved that a carbonyl ligand was reduced

and coupled with the Si atom to give the methylsilane. We report herein the reaction of a silylpentacarbonylmanganese $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with several hydride-transfer reagents. We found that the reaction of **2** with Red-Al (= $\text{Na}[(\text{CH}_3\text{OCH}_2\text{CH}_2\text{O})_2\text{AlH}_2]$) in toluene induces not only the Si–C, but also the C–C coupling reactions (Scheme 1).

2. Results and discussion

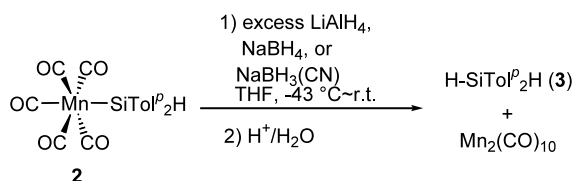
2.1. Reactions of **2** with several hydride-transfer reagents in THF

Treatment of $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with an excess of LiAlH_4 , NaBH_4 , or $\text{NaBH}_3(\text{CN})$ in THF at room temperature afforded dihydrosilane HSiTol_2H (**3**) [9] in high yield (54–91%) together with $\text{Mn}_2(\text{CO})_{10}$ (Scheme 2) [10]. No reduction of CO ligands was observed. This is perhaps because the basic solvent THF induces the heterolysis of the Mn–Si bond in **2** prior to the reaction with the hydride-transfer reagents to give $[\text{HTol}_2\text{Si-THF}]^+[\text{Mn}(\text{CO})_5]^-$ in which the THF-coordinated silyl cation is expected to be highly reactive toward hydride nucleophiles. In fact, when pale yellow **2** was dissolved



Scheme 1.

* Corresponding authors. Fax: +81-22-217-6543 (H.T.).
E-mail address: tobita@inorg.chem.tohoku.ac.jp (H. Tobita).



Scheme 2.

in THF, the solution changed to red instantaneously. The IR spectrum of the solution showed two weak but distinct bands assigned to ν_{CO} at extremely low wavenumber region (1900 and 1865 cm^{-1}) in addition to strong ν_{CO} bands of **2** (2092, 1998 and 1983 cm^{-1}). The intensity ratio of the former bands and those of **2** did not change in the course of time. The former values are almost identical with those of $\text{Na}^+[\text{Mn}(\text{CO})_5]^-$ (1898 and 1863 cm^{-1}) [11]. These facts suggest that when **2** is dissolved in THF, it quickly reaches to equilibrium with $[\text{HTol}_2\text{Si}\cdot\text{THF}]^+[\text{Mn}(\text{CO})_5]^-$ where **2** is the major component.

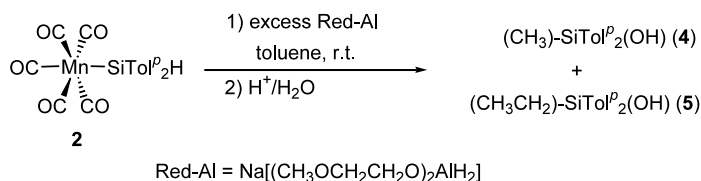
2.2. Reactions of **2** with Red-Al in toluene

By contrast, treatment of **2** with excess Red-Al in toluene at room temperature for 1 day and subsequent addition of aqueous acidic solution gave silanols $(\text{CH}_3)\text{SiTol}_2(\text{OH})$ (**4**) and $(\text{C}_2\text{H}_5)\text{SiTol}_2(\text{OH})$ (**5**) in 43 and 33% yields, respectively (Scheme 3). Neither formation of dihydrosilane **3** nor that of methylsilane **6** and ethylsilane **7** (vide infra) was observed by GC/MS. The formation of **4** and **5** clearly demonstrates that not only the Si–C coupling, but also the C–C coupling occurred efficiently in this reaction.

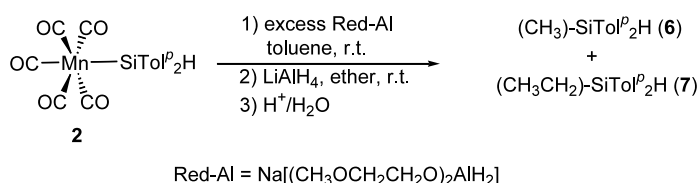
Before hydrolysis, silanols **4** and **5** were not detected in the reaction mixture by GC/MS. Thus the OH group of **4** and **5** originated from water. Actually, treatment of the reaction mixture of **2** and Red-Al with $\text{DCl}/\text{D}_2\text{O}$

gave deuteriosilanols $(\text{CH}_3)\text{SiTol}_2(\text{OD})$ (**4-d**) (ca. 80 atom% D) and $(\text{C}_2\text{H}_5)\text{SiTol}_2(\text{OD})$ (**5-d**) (ca. 80 atom% D) in 40 and 25% yields, respectively. Although isolation of the primary products was unsuccessful, we infer that the primary products were neutral silyl manganese complexes containing $\text{SiTol}_2(\text{CH}_3)$ and $\text{SiTol}_2(\text{C}_2\text{H}_5)$ ligands in which the methyl and ethyl groups on silicon originate from the CO ligands in **2**. These complexes were then hydrolyzed through heterolysis of the Mn–Si bonds [12] to give **4** and **5**. In fact, acid hydrolysis of the model complex $\text{Mn}(\text{CO})_5\text{SiTol}_2(\text{CH}_3)$ proceeded smoothly at room temperature to give $(\text{CH}_3)\text{SiTol}_2(\text{OH})$ (**4**) in 90% yield. This primary formation of neutral silyl manganese complexes was further supported by the following experiment. Treatment of the reaction mixture of **2** and Red-Al with excess LiAlH_4 in diethyl ether instead of hydrolysis gave methylsilane $(\text{CH}_3)\text{SiTol}_2\text{H}$ (**6**) and ethylsilane $(\text{CH}_3\text{CH}_2)\text{SiTol}_2\text{H}$ (**7**) in 41 and 28% yields, respectively (Scheme 4). Use of excess LiAlD_4 instead of LiAlH_4 gave deuteriosilanes $(\text{CH}_3)\text{SiTol}_2\text{D}$ (**6-d**) (ca. 55 atom% D) and $(\text{CH}_3\text{CH}_2)\text{SiTol}_2\text{D}$ (**7-d**) (ca. 53 atom% D) in 41 and 28% yields, respectively. The yields of methylsilane **6** and ethylsilane **7** are almost identical with those of the corresponding hydrolysis products methylsilanol **4** and ethylsilanol **5**. Thus, these yields apparently reflect the proportion of the introduction of methyl and ethyl groups in the silyl ligands in primary products.

In comparison with the iron analogue **1** that did not react with Red-Al but reacted with LiAlH_4 to give methylsilane $(\text{CH}_3)\text{SiTol}_2\text{H}$ (**6**) [8b], manganese complex **2** was reduced under milder conditions and more than one CO ligand were participated in the reaction. These differences are attributable to the following factors: (1) **2** has more CO ligands than iron analogue **1**; and (2) the CO ligands in **2** are more reactive toward nucleophiles than those in **1** because the back-donation to each CO ligand in **2** is weaker than **1**.



Scheme 3.



Scheme 4.

3. Experimental

All manipulations were carried out under a dry nitrogen atmosphere. Reagent-grade hexane, Et₂O, and THF were distilled from sodium–benzophenone ketyl immediately before use. Benzene-*d*₆ and acetone-*d*₆ were dried with molecular sieves 4A. Na[Mn(CO)₅] [13] and Tol₂SiRCl (R = H, Me) [8b] were prepared according to the literature procedures. Na[(CH₃OCH₂-CH₂O)₂AlH₂] (Red-Al) was purchased from Aldrich. Other chemicals were purchased from Wako Pure Chemical Industries, Ltd. and used as received. All NMR spectra were recorded in a Bruker ARX-300 spectrometer. ¹H-, ¹³C- and ²⁹Si-NMR data were referenced to Me₄Si. ²⁹Si-NMR spectra were obtained by the DEPT pulse sequence. IR spectra were recorded in a Horiba FT-200 spectrometer. Mass spectra were recorded on Shimadzu GCMS-QP5050A and JEOL HX-110 mass spectrometers. The D contents in the deuterated products were determined by mass spectroscopy.

3.1. Synthesis of Mn(CO)₅SiTol₂H (**2**)

A THF solution of Na[Mn(CO)₅] (0.99 M, 20 ml, 19.9 mmol) prepared from Mn₂(CO)₁₀ and Na/Hg was slowly cannulated into a two-necked flask connected to a vacuum line and the solvent was removed in vacuo. Then Ar gas was introduced into the reaction vessel and the deoxygenated solution of Tol₂SiHCl (4.65 g, 18.8 mmol) in hexane (20 ml) was added to it by a syringe at –43 °C. The reaction mixture was stirred at room temperature (r.t.) for 12 h and filtered through a Celite pad under nitrogen. The filtrate was evaporated under reduced pressure and the residue was recrystallized from pentane to give **2** (3.33 g, 8.20 mmol, 44% yield) as pale yellow crystals. ¹H-NMR (300 MHz, C₆D₆) δ 7.71–7.73, 7.01–7.04 (AB q, *J* = 8 Hz, 4H × 2; *p*-CH₃C₆H₄), 5.68 (s, 1H; Si–H), 2.05 (s, 6H; *p*-CH₃C₆H₄). ¹³C-NMR (75.5 MHz, C₆D₆) δ 213.2 (CO), 139.1, 135.1, 134.9, 129.3 (*p*-CH₃C₆H₄), 21.3 (*p*-CH₃C₆H₄). ²⁹Si-NMR (59.6 MHz, C₆D₆) δ 7.84. IR (cm^{–1}, KBr pellet): ν(Si–H) 2108, ν(CO) 2092, 1998, 1983. Mass (EI, 70 eV); *m/z*: 406 (M⁺, 2), 378 (M⁺ – CO, 9), 322 (M⁺ – 3CO, 5), 211 (M⁺ – Mn(CO)₅, 100). Anal. Found: C, 56.23; H, 3.59. Calc. for C₁₉H₁₅MnO₅Si: C, 56.16; H, 3.72%.

3.2. Reaction of Mn(CO)₅SiTol₂H (**2**) with LiAlH₄ in THF

To a suspension of LiAlH₄ (298 mg, 7.83 mmol) in THF (15 ml) was added a THF solution (5 ml) of **2** (789 mg, 1.94 mmol) at –43 °C. The mixture was allowed to warm to r.t. and was stirred for 4 h. After

removal of solvent in vacuo, the residue was extracted with hexane and the extract was filtered through a Celite pad under nitrogen. The solvent was removed in vacuo and the residue was subjected to silica gel flash chromatography (12 mm o.d. × 30 mm) with 1/5 toluene–hexane as eluent to give Tol₂SiH₂ (504 mg, 1.77 mmol) as a colorless liquid in 91% yield together with Mn₂(CO)₁₀ (87.1 mg, 223 μmol) as a bright yellow powder in 23% yield.

3.3. Reaction of Mn(CO)₅SiTol₂H (**2**) with NaBH₄ in THF

To a suspension of NaBH₄ (308 mg, 8.11 mmol) in THF (15 ml) was added a THF solution (5 ml) of **2** (804 mg, 1.98 mmol) at –43 °C. The mixture was allowed to warm to r.t. and was stirred for 1 day. The reaction mixture was worked up in a manner similar to that for the reaction with LiAlH₄ to give Tol₂SiH₂ (475 mg, 1.67 mmol) in 84% yield together with Mn₂(CO)₁₀ (122 mg, 312 μmol) in 32% yield.

3.4. Reaction of Mn(CO)₅SiTol₂H (**2**) with NaBH₃(CN) in THF

To a suspension of NaBH₃(CN) (673 mg, 8.10 mmol) in THF (15 ml) was added a THF solution (5 ml) of **2** (798 mg, 1.97 mmol) at –43 °C. The mixture was allowed to warm to r.t. and was stirred for 2 days. The reaction mixture was worked up in a manner similar to that for the reaction with LiAlH₄ to give Tol₂SiH₂ (302 mg, 514 μmol) in 54% yield together with Mn₂(CO)₁₀ (200 mg, 514 μmol) in 52% yield.

3.5. Reaction of Mn(CO)₅SiTol₂H (**2**) with Red-Al and subsequent hydrolysis

A toluene solution of Red-Al (3.4 M, 30 ml, 102 mmol) was added dropwise to a solution of **2** (4.09 g, 10.1 mmol) in toluene (50 ml) over a period of 30 min and then stirred for 1 day at r.t. The reaction mixture was cooled in an ice bath, and EtOAc (10 ml) was added dropwise to destroy an excess of Red-Al. Then aqueous HCl solution (1 M, 200 ml) was added and the organic layer was washed with saturated NaHCO₃ solution, water, and saturated NaCl solution, and then dried over anhydrous MgSO₄. Removal of solvent in vacuo gave a mixture of (CH₃)SiTol₂(OH) (**4**) (1.05 g, 4.34 mmol), and (C₂H₅)SiTol₂(OH) (**5**) (853 mg, 3.33 mmol) in 43 and 33% yields, respectively. All the products were identified by comparing the ²⁹Si-NMR and GC/MS data with those of the authentic samples. Yields were determined by quantitative analysis with GC/MS.

3.6. Reaction of $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with Red-Al and subsequent treatment with $\text{DCl}/\text{D}_2\text{O}$

A toluene solution of the reaction mixture of **2** (215 mg, 529 μmol) and Red-Al (3.4 M, 0.3 ml, 1.02 mmol) was added dropwise to $\text{DCl}/\text{D}_2\text{O}$ solution (1 M, 200 ml). The reaction mixture was worked up in a manner similar to that for the reaction with $\text{HCl}/\text{H}_2\text{O}$ to give a mixture of $(\text{CH}_3)\text{SiTol}_2(\text{OD})$ (**4-d**: ca. 80 atom% D) (51.6 mg, 212 μmol) and $(\text{C}_2\text{H}_5)\text{SiTol}_2(\text{OD})$ (**5-d**: ca. 80 atom% D) (34.0 mg, 132 μmol) in 40 and 25% yields, respectively.

3.7. Acid hydrolysis of $\text{Mn}(\text{CO})_5\text{SiTol}_2(\text{CH}_3)$

To a Et_2O solution (50 ml) of $\text{Mn}(\text{CO})_5\text{SiTol}_2(\text{CH}_3)$ (563 mg, 1.34 mmol) was added aqueous HCl (1 M, 200 ml) at r.t. and then stirred for 1 day. The mixture was placed in a separatory funnel. The organic layer was separated, washed with saturated NaHCO_3 solution, water, and saturated NaCl solution, and then dried over anhydrous MgSO_4 . The solvent was removed in vacuo to give $(\text{CH}_3)\text{SiTol}_2(\text{OH})$ (**4**) (292 mg, 121 mmol) in 90% yield.

3.8. Reaction of $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with Red-Al and subsequent treatment with LiAlH_4

A toluene solution of Red-Al (3.4 M, 7.3 ml, 24.8 mmol) was added dropwise to a solution of **2** (912 mg, 2.25 mmol) in toluene (20 ml) over a period of 10 min and then stirred for 18 h at r.t. The reaction mixture was added dropwise to a Et_2O solution (30 ml) of LiAlH_4 (997 mg, 26.2 mmol) at r.t. and stirred for 3 h. Hydrolysis and workup in a manner similar to those in Section 3.5 gave a mixture of $(\text{CH}_3)\text{SiTol}_2\text{H}$ (**6**) [8b] (208 mg, 920 μmol) and $(\text{CH}_3\text{CH}_2)\text{SiTol}_2\text{H}$ (**7**) (151 mg, 629 μmol) in 41 and 28% yields, respectively.

3.9. Reaction of $\text{Mn}(\text{CO})_5\text{SiTol}_2\text{H}$ (**2**) with Red-Al and subsequent treatment with LiAlD_4

A toluene solution of the reaction mixture of **2** (387 mg, 952 μmol) and Red-Al (3.4 M, 0.5 ml, 1.70 mmol) was added dropwise to a Et_2O solution (10 ml) of LiAlD_4 (339 mg, 8.07 mmol). The reaction mixture was worked up in a manner similar to that for the reaction with LiAlH_4 to give a mixture of $(\text{CH}_3)\text{SiTol}_2\text{D}$ (**6-d**: ca. 55 atom% D) [8b] (88.7 mg, 390 μmol) and $(\text{CH}_3\text{CH}_2)\text{SiTol}_2\text{D}$ (**7-d**: ca. 53 atom% D) (64.5 mg, 267 μmol) in 41 and 28% yields, respectively.

3.10. Preparation of $\text{ToI}_2\text{SiMe}(\text{OH})$ (**4**)

To a Et_2O solution (30 ml) of $\text{ToI}_2\text{SiMeCl}$ (5.23 g, 20.1 mmol) and phenolphthalein was added 1 M NaOH

aqueous solution until the solution was neutralized. The mixture was placed in a separatory funnel. The organic layer was separated, washed with 1 M HCl aqueous solution (10 ml $\times$ 3), saturated NaHCO_3 solution (10 ml), water (10 ml $\times$ 3), and saturated NaCl solution (10 ml), and then dried over anhydrous MgSO_4 . The solvent was removed in vacuo to give **4** (4.50 g, 18.6 mmol) in 93% yield as a colorless oil. $^1\text{H-NMR}$ (300 MHz, acetone- d_6) δ 7.20–7.23, 7.59–7.62 (AB q, $J = 8.1$ Hz, $4\text{H} \times 2$; $p\text{-CH}_3\text{C}_6\text{H}_4$), 5.62 (br, 1H; Si–OH), 2.34 (s, 6H; $p\text{-CH}_3\text{C}_6\text{H}_4$), 0.65 (s, 3H; Si–Me). $^{13}\text{C-NMR}$ (75.5 MHz, acetone- d_6) δ 139.6, 135.9, 134.7, 129.1 ($p\text{-CH}_3\text{C}_6\text{H}_4$), 21.5 ($p\text{-CH}_3\text{C}_6\text{H}_4$), -0.56 (Si–Me). $^{29}\text{Si-NMR}$ (59.6 MHz, acetone- d_6) δ -0.84 . Mass (EI, 70 eV); m/z : 242 (M^+ , 37), 227 ($\text{M}^+ - \text{Me}$, 100). Exact mass found: 242.1126. Calc. for $\text{C}_{15}\text{H}_{18}\text{OSi}$: 242.1127.

3.11. Preparation of $\text{ToI}_2\text{SiEt}(\text{OH})$ (**5**)

A 2 l four-necked flask was equipped with a condenser, a mechanical stirrer, and a dropping funnel. EtSiCl_3 (78.5 g, 480 mmol) and THF (650 ml) were placed in the flask. A THF solution of ToI^pMgCl (1.00 M, 800 ml, 800 mmol) was added dropwise from the dropping funnel into the flask over a period of 1 h, and then the mixture was refluxed for an additional 5 h. After the reaction mixture was allowed to cool to r.t., it was filtered and the salt was washed with Et_2O (3 l). The filtrate was concentrated and the residue was distilled under reduced pressure to give $\text{ToI}_2\text{SiEtCl}$ (61.3 g, 223 mmol, 46%) as a colorless oil, b.p. $134^\circ\text{C}/0.3$ mmHg. $^1\text{H-NMR}$ (300 MHz, C_6D_6) δ 7.57–7.59, 6.99–7.02 (AB q, $J = 8$ Hz, $4\text{H} \times 2$; $p\text{-CH}_3\text{C}_6\text{H}_4$), 2.08 (s, 6H; $p\text{-CH}_3\text{C}_6\text{H}_4$), 1.19 (quartet, $^3J(\text{H,H}) = 7$ Hz, 2H; Si– CH_2CH_3), 1.09 (t, $^3J(\text{H,H}) = 7$ Hz, 3H; Si– CH_2CH_3). $^{13}\text{C-NMR}$ (75.5 MHz, C_6D_6) δ 140.6, 134.8, 130.6, 129.2 ($p\text{-CH}_3\text{C}_6\text{H}_4$), 21.5 ($p\text{-CH}_3\text{C}_6\text{H}_4$), 9.10, 7.02 (Si–Et). $^{29}\text{Si-NMR}$ (59.6 MHz, C_6D_6) δ 13.0. Mass (EI, 70 eV); m/z : 274 (M^+ , 12), 245 ($\text{M}^+ - \text{Et}$, 100).

Hydrolysis of $\text{ToI}_2\text{SiEtCl}$ (5.64 g, 20.5 mmol) in a manner analogous to that for **4** gave $\text{ToI}_2\text{SiEt}(\text{OH})$ (**5**) (4.85 g, 18.9 mmol, 92%) as a colorless oil. $^1\text{H-NMR}$ (300 MHz, acetone- d_6) δ 7.50–7.52, 7.16–7.19 (AB q, $J = 8$ Hz, $4\text{H} \times 2$; $p\text{-CH}_3\text{C}_6\text{H}_4$), 5.52 (br, 1H; Si–OH), 2.30 (s, 6H; $p\text{-CH}_3\text{C}_6\text{H}_4$), 1.02 (br s, 5H; Si–Et). $^{13}\text{C-NMR}$ (75.5 MHz, acetone- d_6) δ 139.7, 135.0, 134.9, 129.1 ($p\text{-CH}_3\text{C}_6\text{H}_4$), 21.4 ($p\text{-CH}_3\text{C}_6\text{H}_4$), 7.94, 7.10 (Si–Et). $^{29}\text{Si-NMR}$ (59.6 MHz, acetone- d_6) δ -0.90 . Mass (EI, 70 eV); m/z : 256 (M^+ , 5), 227 ($\text{M}^+ - \text{Et}$, 100). Exact mass found: 256.1281. Calc. for $\text{C}_{16}\text{H}_{20}\text{OSi}$: 256.1283.

3.12. Preparation of ToI_2SiHEt (**7**)

To a Et_2O solution of EtMgBr (0.875 M, 120 ml, 105 mmol) was added a Et_2O solution (60 ml) of ToI_2SiHCl

(13.0 g, 52.4 mmol) over a period of 5 min. The mixture was stirred at r.t. for 1.5 h and then cooled in an ice bath. Water (20 ml) was added dropwise to hydrolyze an excess of EtMgBr and then 6 M HCl (100 ml) was added to dissolve the salt. The aqueous layer was extracted with two 50 ml portions of ether and the combined organic layer was washed with saturated NaHCO₃ solution (200 ml), water (200 ml), and saturated NaCl solution (200 ml) and then dried over anhydrous MgSO₄. After removal of solvent, the residue was distilled under reduced pressure to give **7** (10.9 g, 45.4 mmol, 87%) as a colorless oil, b.p. 114 °C/0.2 mmHg. ¹H-NMR (300 MHz, C₆D₆) δ 7.51–7.53, 7.02–7.05 (AB q, *J* = 8 Hz, 4H × 2; *p*-CH₃C₆H₄), 5.10 (t, ³*J*(H,H) = 4 Hz, 1H; Si–H), 2.10 (s, 6H; *p*-CH₃C₆H₄), 1.08 (br s, 5H; Si–Et). ¹³C-NMR (75.5 MHz, C₆D₆) δ 139.4, 135.6, 131.2, 129.1 (*p*-CH₃C₆H₄), 21.4 (*p*-CH₃C₆H₄), 8.40, 4.77 (Si–Et). ²⁹Si-NMR (59.6 MHz, C₆D₆) δ –11.6. IR (cm^{–1}, NaCl plate): ν(Si–H) 2110. Mass (EI, 70 eV); *m/z*: 240 (M⁺, 37), 211 (M⁺ – Et, 100), 148 (M⁺ – H – Tol^l, 42), 119 (M⁺ – H – Et – Tol^l, 18). Anal. Found: C, 79.79; H, 8.44. Calc. for C₁₆H₂₀Si: C, 79.93; H, 8.38%.

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