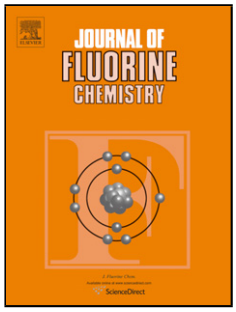

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Reactions of organozinc reagents with potassium bromodifluoroacetate

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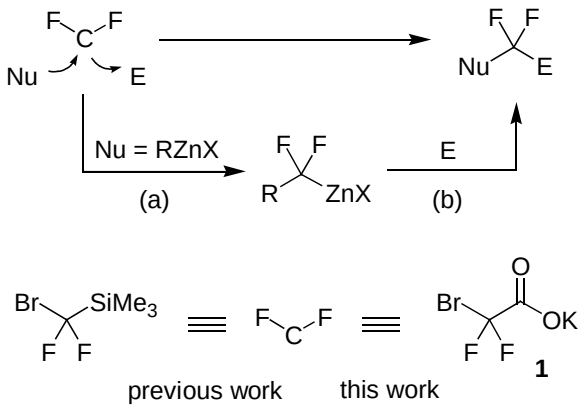
Abstract A practical method for the synthesis of *gem*-difluorinated compounds from organozinc reagents is described. Potassium bromodifluoroacetate serves as a source of CF_2-fragment, which is inserted into carbon-zinc bond of organozinc reagents. The intermediate difluorinated organozinc species can be protonated, brominated or coupled with allylic electrophiles.

Keywords: organozinc reagents, *gem*-difluorinated compounds, potassium bromodifluoroacetate, difluorocarbene

1. Introduction

Compounds bearing difluoromethylene fragment constitute an important class of fluorinated molecules with potential applications in medicinal chemistry [1]. Owing to specific fluorine effect, *gem*-difluorinated substances have been evaluated within a variety of structural settings, such as carbohydrides [2], peptides [3], and aliphatic chains [4]. Several general approaches for the preparation of compounds with CF_2 unit have been reported [5] involving deoxofluorination [6], use of building blocks [2a,5], and difluorocyclopropanation [7].

Recently we introduced a novel methodology for assembling *gem*-difluorinated compounds from difluorocarbene, nucleophile and electrophile (Scheme 1) [8,9]. When organozinc reagents are used as nucleophiles, the addition to difluorocarbene (step a) and reaction with electrophile (step b) can be performed in a consecutive manner thereby allowing for independent variation of nucleophile and electrophiles [10]. In these processes, (bromodifluoromethyl)trimethylsilane [11] activated by a Lewis base was used as a source of difluorocarbene [12]. Though this silane can be made from the Ruppert-Prakash reagent in one or two steps [9a,11a], it is quite expensive. Herein we demonstrate that potassium bromodifluoroacetate (**1**), which can be obtained from readily available ethyl ester [13], can serve as a practical alternative to Me_3SiCF_2Br in reaction with organozincs.



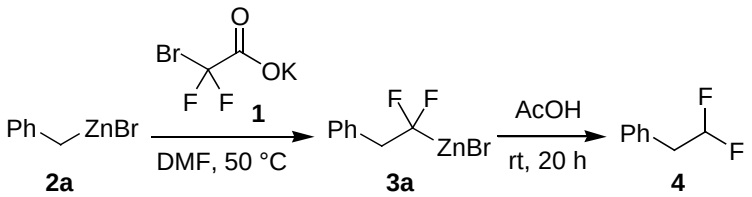
Scheme 1. Assembling of molecules containing CF_2-fragment.

2. Results and discussion

Benzylzinc bromide (**2a**) prepared from benzyl bromide in tetrahydrofuran was selected as a model organozinc reagent and its reaction with potassium bromodifluoroacetate (**1**) was evaluated (Table 1). Decarboxylation of bromodifluoroacetate anion requires elevated temperatures which may cause decomposition of species **3a**. Earlier we observed that decomposition of fluorinated organozinc reagents is slowed down by dimethylformamide [8a], and, therefore, herein we used it as a major solvent. Thus, a solution of **2a** (2M in THF) was diluted with three volumes of DMF and treated with 2 equiv of salt **1**. The evolution of carbon dioxide proceeded at 50 °C leading, after treatment with acetic acid, to 2,2-difluoroethylbenzene **4** in 62% yield determined by ^{19}F NMR analysis (entry 1). Increasing the amount of difluorocarbene source and performing the reaction at longer period had virtually no increase in yield of **4**, while providing more by-products along with darkening of reaction mixture, which may be associated with side processes involving excessive difluorocarbene. Furthermore, in these experiments we observed that the reaction rate decreases at higher conversions. The latter phenomenon may be associated with the transformation of starting benzylzinc bromide **2a** into more Lewis acidic organozinc species **3a**, which stronger interacts with bromodifluoroacetate anion thus impeding decarboxylation. In an attempt to cope with decelerating effect, the reaction was performed in the presence of nucleophilic acetate anion (entries 3 and 4). Though in these cases there was no increase in yield, the reaction mixtures were notably cleaner (^{19}F NMR control). Finally, the use of tetraethylammonium bromide as an additive (0.5 equiv) was found to be optimal, and the product **4** was formed in 70% yield within 45 minutes (entry 6). In a preparative experiment carried out on 20 mmol scale of benzylzinc bromide **2a**, volatile product **4** was isolated in 55 % yield after distillation.

Table 1.

Reaction of benzylzinc bromide.



2a **3a** **4**

Entry	Equiv of **1**	Additive	Equiv	Time, min[a]	Yield of **4**, %[b]
1	2	–	–	80	62
2	2.5	–	–	120	62
3	1.5	AcOK	0.5	60	53
4	1.5	Bu_4NOAc	1	60	55
5	1.5	Et_4NBr	0.5	45	60
6	**2**	**Et_4NBr**	**0.5**	**45**	**70 (55[c])**
7	2	Et_4NBr	2	15	58
8[d]	2	Et_4NBr	2	25	70

[a] Time for conversion **2a** to **3a**.

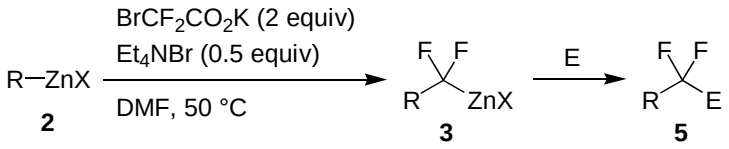
[b] Yield determined by ^{19}F NMR using $PhCF_3$ as internal standard.

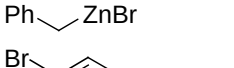
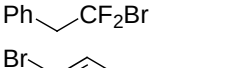
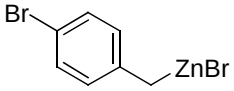
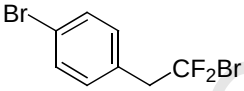
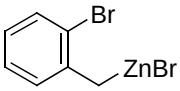
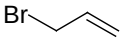
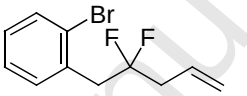
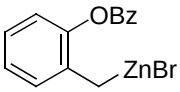
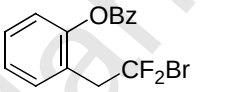
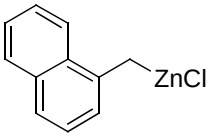
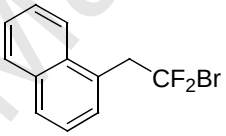
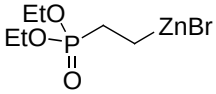
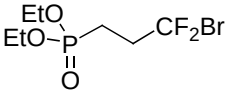
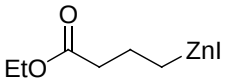
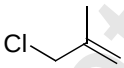
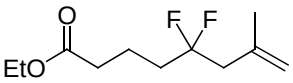
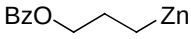
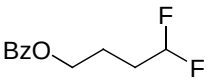
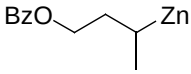
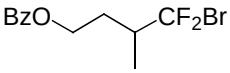
[c] Isolated yield.

[d] Reaction of **2a** with **1** was performed at 45 °C.

Under the optimized conditions, a variety of organozinc reagents **2** were reacted with potassium bromodifluoroacetate (Table 2). The intermediate difluorinated organozincs **3** were quenched with bromine or acetic acid or coupled with allylic electrophile [8b,9b]. The reaction was successfully applied to benzyl and alkyl organozinc reagents furnishing products **5a-i** in 45-85% yield. However, reactions involving aromatic organozincs were unsuccessful.

Table 2.
Reactions of organozinc reagents



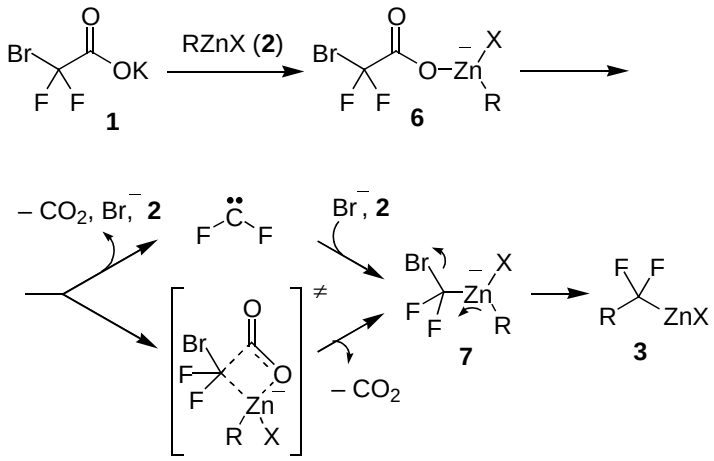
2		E	Time, min[a]	5		Yield of 5, %[a]
	**2a**	Br_2	60		**5a**	60
	**2b**	Br_2	60		**5b**	56
	**2c**	 10% CuCN	55		**5c**	58
	**2d**	Br_2	50		**5d**	51
	**2e**	Br_2	40		**5e**	45
	**2f**	Br_2	80		**5f**	67
	**2g**	 10% CuCN	80		**5g**	65
	**2h**	AcOH	60		**5h**	60
	**2i**	Br_2	50		**5i**	85

[a] Time for conversion **2** to **3**.

[b] Isolated yield.

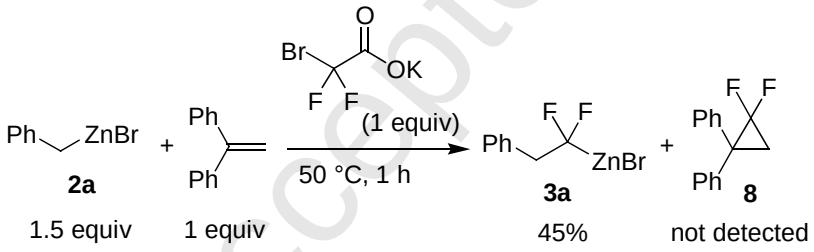
Proposed reaction mechanism is shown in Scheme 2. First, bromodifluoroacetate anion binds to a zinc of starting reagent **2** leading to ate complex **6**. Its transformation into decarboxylated species **7** may proceed either through free difluorocarbene followed by trapping with bromide ion and reagent **2** (upper path) [14] or in a concerted fashion (lower path). At the final step, zincate **7** undergoes loss of bromide with concomitant migration of R group from zinc to carbon affording final organozinc species **3** [15]. Several other mechanisms cannot be excluded such as concerted

insertion of difluorocarbene into C-Zn bond or intermediate formation of difluorocarben-zinc complexes [16], they believed to be less likely.



Scheme 2. Proposed reaction mechanism.

In an attempt to trap difluorocarbene, the reaction of slight excess (1.5 equiv) of benzylzinc bromide **2a** with potassium bromodifluoroacetate was performed in the presence of 1,2-diphenylethylene (Scheme 3). Analysis of reaction mixture by ^{19}F NMR spectroscopy showed the formation organozinc species **3a**, while difluorocyclopropane **8** was not detected. This experiment suggests that either the decarboxylation proceeds in a concerted fashion or difluorocarbene interacts with bromide ion faster than with 1,2-difluoroethylene.



Scheme 3. Attempted trapping experiment.

3. Conclusions

In summary, a convenient protocol for the synthesis of *gem*-difluorinated compounds from oranozinc reagents and potassium bromodifluoroacetate and a suitable electrophile is described. Though the method provides a bit lower yields compared to that involving (bromodifluoromethyl)trimethylsilane, the procedure is practical, being suitable for multi-gram reactions, and employs a cheaper source of difluoromethylene fragment.

4. Experimental

4.1 General Experimental Procedures

All reactions were performed under an argon atmosphere. DMF was distilled under vacuum from P_2O_5 and stored over MS 4Å. NMR spectra were recorded on a Bruker AM-300 instrument. Microanalyses were performed on KarloErba 1106 instrument. Organozinc reagents **2a-h** were prepared in THF from corresponding bromides or iodides according to a literature procedure [8a]. Organozinc reagent **2i** was obtained from 3-bromobutyl benzoate using typical procedure [8a] (for the preparation of 3-bromobutyl benzoate see section 4.2.).

4.2. 3-Bromobutyl benzoate.

A solution of Ph_3P (29.2 mmol, 7.65 g) and imidazole (29.2 mmol, 1.99 g) in dry CH_2Cl_2 (40 mL) was cooled to 0 °C and then bromine (29.2 mmol, 1.5 mL) was added dropwise. To the resulting orange suspension, 3-hydroxybutyl benzoate [17] (24.3 mmol, 4.72 g) was added, the reaction was allowed to warm to a room temperature and stirred for 20 hours. Solvent was evaporated under vacuum and the residue was diluted with hexane (50 mL). The resulting white precipitate was filtered and washed with hexane (3×10 mL). The combined organic phases were concentrated under vacuum, and the residue was chromatographed on silica gel (hexane/EtOAc, 12/1, R_f 0.37) affording 5.5 g (88% yield) of 3-bromobutyl benzoate as a colorless oil. ^{1}H NMR (300 MHz, $CDCl_3$), δ: 1.78 (d, 3H, J = 6.6 Hz), 2.16–2.24 (m, 1H), 2.24–2.33 (m, 1H), 4.30 (qdd, 1H, J = 6.7, 6.6, 2.1 Hz), 4.38–4.49 (m, 1H), 4.49–4.58 (m, 1H), 7.43 (dd, 2H, J = 7.6, 7.5 Hz), 7.56 (t, 1H, J = 7.5 Hz), 8.03 (d, 2H, J = 7.6 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 26.6, 39.9, 47.0, 63.1, 128.5, 129.7, 130.2, 133.1, 166.4. HRMS (ESI): Calcd for $C_{11}H_{13}BrO_2Na$ $[M + Na]^+$: 278.9991. Found: 278.9993.

*4.3. Synthesis of products **4** and **5a**.*

To a solution of benzylzinc bromide (20 mmol, 10 mL, 2M in THF) were successively added DMF (30 mL), Et_4NBr (2.10 g, 10 mmol) and $BrCF_2CO_2K$ (8.52 g, 40 mmol) at room temperature. The mixture was vigorously stirred for 45 min at 50 °C, then cooled to room temperature affording a solution of reagent **3a**.

*4.3.1. (2,2-Difluoroethyl)benzene (**4**)* [18].

From a solution of reagent **3a**, tetrahydrofuran was evaporated under vacuum (1 Torr) at room temperature. Then, the reaction flask containing a solution of **3a** was immersed in an ice/water bath followed by addition of AcOH (3.43 mL, 60 mmol). The cooling bath was removed, and the mixture was stored for 20 hours at room temperature. The mixture was diluted with water (60 mL) and extracted with pentane (3×10 mL). The combined organic phases were washed with 5M HCl (5 mL), filtered through Na_2SO_4. The solvent was evaporated at atmospheric pressure, and the residue was distilled under vacuum affording 1.56 g (55%) of **4** as colorless liquid. Bp 62–64 °C/40 Torr.

*4.3.2. (2-Bromo-2,2-difluoroethyl)benzene (**5a**).*

A solution of **3a** was cooled to –20°C, and bromine (22 mmol 1.15 mL) was added. The cooling bath was removed, and the mixture was stirred for 1 hour at room temperature. Then, a solution of $Na_2S_2O_3 \cdot 5H_2O$ (5.0 g) in water (15 mL), water (30 mL), and 2M HCl (10 mL) were successively added with stirring. The mixture was extracted with pentane (15 mL and 2×10 mL), the combined organic phases were concentrated at atmospheric pressure, and the residue was fractionally distilled under vacuum. Yield 5.65 g (60%). Colorless liquid. Bp 78–81 °C/20 Torr. ^{1}H NMR (300 MHz, $CDCl_3$) δ: 3.67 (t, 2H, J = 14.3 Hz), 7.28 (m, 5H). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 50.4 (t, J = 22.5 Hz), 121.8 (t, J = 306.0 Hz), 128.3, 128.7, 130.7, 131.5 (t, J = 3.2 Hz). ^{19}F NMR (282 MHz, $CDCl_3$) δ: –45.4 (t, J = 14.3 Hz). Anal. calcd for $C_{12}H_9BrF_2$: C, 43.47; H, 3.19; found: C, 43.25; H, 3.41.

*4.4. Preparation of **5b-i** (General procedure)*

A tetrahydrofuran solution of RZnX (1.5 mmol) was concentrated under vacuum to a viscous oil. Then to the residue DMF (2.3 mL), Et_4NBr (158 mg, 0.75 mmol) and $BrCF_2CO_2K$ (639 mg, 3.0 mmol) were successively added. The mixture was vigorously stirred at 50°C during the time indicated in Table 2. The resulting mixture, containing difluorinated reagent **3**, was reacted with an electrophile as described below.

Protonation. The reaction flask was immersed in an ice/water bath. AcOH (257 μL, 4.5 mmol) was added, the cooling bath was removed, and the mixture was stored for 20 hours at room temperature. The mixture was diluted with water (12 mL) and extracted with hexane (3×5 mL). The combined organic phases were washed were filtered through Na_2SO_4, concentrated under vacuum, and the residue was chromatographed on silica gel.

Bromination. The reaction flask was immersed in an ice/water bath and bromine (1.65 mmol, 85 μL) was added. Cooling bath was removed and the mixture was stirred for 1 hour at room temperature, then diluted with 0.5M solution of $Na_2S_2O_3$ and extracted with hexane (3×5 mL). The combined organic phases were filtered through Na_2SO_4, concentrated either under vacuum, and the residue was chromatographed on silica gel.

Allylation. The reaction flask was immersed in an ice/water bath and allyl bromide or methallyl chloride (3 mmol) and CuCN (13.4 mg, 0.15 mmol) were added. The resulting suspension was stirred for 1 hour, then the cooling bath was removed and stirring was continued for 16 hours. The mixture was diluted with water (12 mL) and extracted with hexane (3×5 mL). The combined organic phases were filtered through Na_2SO_4, concentrated under vacuum, and the residue was chromatographed on silica gel.

*4.4.1. 1-Bromo-4-(2-bromo-2,2-difluoroethyl)benzene (**5b**)*

Yield 252 mg (56%). Colorless liquid. R_f 0.34 (hexane). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 3.60 (t, 2H, *J* = 14.4 Hz), 7.18 (d, 2H, *J* = 8.2 Hz), 7.50 (d, 2H, *J* = 8.2 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 49.7 (t, *J* = 23.0 Hz), 121.1 (t, *J* = 306.0 Hz), 122.6, 130.3 (t, *J* = 2.9 Hz), 131.8, 132.2. ^{19}F (282 MHz, $CDCl_3$), δ: –45.8 (t, *J* = 14.4 Hz). Anal. calcd for $C_8H_6Br_2F_2$: C, 32.04, H, 2.02; found: C, 32.13; H, 2.14.

*4.4.2. 1-Bromo-2-(2,2-difluoropent-4-en-1-yl)benzene (**5c**).*

Yield 221 mg (58%). Colorless liquid. R_f 0.38 (hexane). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 2.66 (td, 2H, *J* = 16.2, 7.0 Hz), 3.40 (t, 2H, *J* = 16.3 Hz), 5.22 (dd, 1H, *J* = 17.8, 1.2 Hz), 5.25 (dd, 1H, *J* = 8.8, 1.2 Hz), 5.87 (ddt, 1H, *J* = 17.8, 8.8, 7.0 Hz), 7.15 (ddd, 1H, *J* = 8.1, 8.0, 1.8 Hz), 7.28 (ddd, 1H, *J* = 8.0, 7.3, 1.8 Hz), 7.39 (d, 1H, *J* = 7.3 Hz), 7.59 (dd, 1H, *J* = 8.1 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 41.1 (t, *J* = 25.3 Hz), 41.9 (t, *J* = 25.9 Hz), 120.5, 123.0 (t, *J* = 244.0 Hz), 125.9, 127.5, 129.1, 129.3 (t, *J* = 5.5 Hz), 132.4 (t, *J* = 1.5 Hz), 133.1, 133.2 (t, *J* = 4.0 Hz). ^{19}F (282 MHz, $CDCl_3$), δ: –96.6 (tt, *J* = 16.3, 16.2 Hz). Anal. calcd for $C_{11}H_{11}BrF_2$: C, 50.60, H, 4.25; found: C, 50.64; H, 4.41.

*4.4.3. 2-(2-Bromo-2,2-difluoroethyl)phenyl benzoate (**5d**).*

Yield 260 mg (51%). Colorless crystals. Mp 39–40°C R_f 0.28 (hexane/EtOAc, 15/1). ^{1}H NMR (300 MHz, $CDCl_3$) δ: 3.75 (t, 2H, *J* = 13.9 Hz), 7.26–7.36 (m, 2H Hz), 7.46 (t, 2H, *J* = 7.2 Hz), 7.50–7.60 (m, 2H), 7.68 (t, 1H, *J* = 7.4 Hz), 8.26 (d, 2H, *J* = 7.4 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 44.6 (t, *J* = 23.6 Hz), 121.0 (t, *J* = 306.6 Hz), 123.1, 123.7 (t, *J* = 2. Hz 9), 126.1, 128.7, 129.2, 129.7, 130.2, 132.5, 133.9, 149.9, 164.6. ^{19}F NMR (282 MHz, $CDCl_3$) δ: –44.9 (t, *J* = 13.9 Hz). Anal. calcd for $C_{15}H_{11}BrF_2$: C, 52.81; H, 3.25; found: C, 52.84; H, 3.29.

*4.4.4. 1-(2-Bromo-2,2-difluoroethyl)naphthalene (**5e**).*

Yield 182 mg (45%). Colorless oil. R_f 0.34 (hexane). ^{1}H NMR (300 MHz, $CDCl_3$) δ: 4.22 (t, 2H, *J* = 14.6 Hz), 7.46–7.67 (m, 4H), 7.86–7.98 (m, 2H); 8.08 (d, 1H, *J* = 8.1 Hz). ^{13}C NMR (75 MHz,

$CDCl_3$) δ: 46.9 (t, *J* = 22.5 Hz), 121.8 (t, *J* = 307.2 Hz), 123.9 (t, *J* = 1.8 Hz), 125.3, 125.9, 126.6, 127.6 (t, *J* = 2.4 Hz), 128.9, 129.3, 130.1, 132.5, 134.0. ^{19}F NMR (282 MHz, $CDCl_3$) δ: –44.0 (t, *J* = 14.6 Hz). Anal. calcd for $C_{12}H_9BrF_2$: C, 53.16; H, 3.35; found: C, 53.19; H, 3.37.

*4.4.5. Diethyl (3-bromo-3,3-difluoropropyl)phosphonate (**5f**).*

Yield 296 mg (67%). Pale-yellow liquid. R_f 0.28 (hexane/EtOAc, 1/1). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 1.20 (t, 6H, *J* = 7.0 Hz), 1.78–1.97 (m, 2H), 2.38–2.60 (m, 2H), 3.89–4.10 (m, 4H). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 16.2 (d, *J* = 5.8 Hz), 20.7 (d, *J* = 146.3 Hz), 38.0 (td, *J* = 23.6, 1.5 Hz), 62.0 (d, *J* = 6.3 Hz), 121.7 (td, *J* = 305.2, 25.9 Hz). ^{19}F (282 MHz, $CDCl_3$), δ: –46.9 (t, *J* = 12.7 Hz). HRMS (ESI): Calcd for $C_{17}H_{14}BrF_2O_3PNa$ $[M + Na]^+$: 316.9724. Found: 316.9733.

*4.4.6. Ethyl 5,5-difluoro-7-methyloct-7-enoate (**5g**).*

Yield 214 mg (65%). Colorless oil. R_f 0.18 (hexane/CH_2Cl_2, 2/1). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 1.21 (t, 3H, *J* = 7.2 Hz), 1.68–1.93 (m, 2H), 2.31 (t, 2H, *J* = 6.8 Hz), 2.52 (t, 2H, *J* = 16.3 Hz), 4.09 (q, 2H, *J* = 7.2 Hz), 4.81 (s, 1H), 4.92 (s, 1H). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 14.2, 17.8 (t, *J* = 4.9 Hz), 23.2 (t, *J* = 1.8 Hz), 33.7, 35.2 (t, *J* = 25.3 Hz), 44.7 (t, *J* = 25.3 Hz), 60.4, 116.5, 124.3 (t, *J* = 242.7 Hz), 138.4 (t, *J* = 4.0 Hz), 173.0. ^{19}F (282 MHz, $CDCl_3$), δ: –96.3 (quint, *J* = 16.5 Hz). HRMS (ESI): Calcd for $C_{11}H_{18}F_2O_2Na$ $[M + Na]^+$: 243.1167. Found: 243.1167.

*4.4.7. 4,4-Difluorobutyl benzoate (**5h**).*

Yield 192 mg (60%). Colorless oil, R_f 0.20 (hexane/EtOAc, 15/1). ^{1}H NMR (300 MHz, $CDCl_3$) δ: 1.87–2.12 (m, 4H), 4.36 (t, 2H, *J* = 5.9 Hz), 5.89 (tt, *J* = 55.7, 3.9 Hz), 7.43 (t, 2H, *J* = 7.5 Hz), 7.55 (t, 1H, *J* = 7.3 Hz), 8.03 (d, 2H, *J* = 7.3 Hz). ^{13}C NMR (75 MHz, $CDCl_3$) δ: 21.6 (t, *J* = 5.5 Hz), 31.0 (t, *J* = 21.3 Hz), 63.9, 116.8 (t, *J* = 239.0 Hz), 128.4, 129.5, 130.1, 133.0, 166.4. ^{19}F NMR (282 MHz, $CDCl_3$) δ: –117.1 (dt, *J* = 55.7, 17.0 Hz). Anal. calcd for $C_{11}H_{12}F_2O_2$: C, 61.68; H, 5.65; found: C, 61.67; H, 5.70.

*4.4.8. 4-Bromo-4,4-difluoro-3-methylbutyl benzoate (**5i**).*

Yield 420 mg (85%). Colorless oil. R_f 0.27 (hexane/EtOAc, 20/1). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 1.23 (d, 3H, *J* = 6.6 Hz), 1.68–1.82 (m, 1H), 2.20–2.25 (m, 1H), 2.36–2.50 (m, 1H), 4.36–4.46 (m, 2H), 7.45 (dd, 2H, *J* = 7.4, 7.3 Hz), 7.57 (t, 1H, *J* = 7.4 Hz), 8.04 (d, 2H, *J* = 7.3 Hz). ^{13}C NMR (75 MHz, $CDCl_3$), δ: 14.7 (dd, *J* = 4.0, 2.3 Hz), 30.7 (dd, *J* = 3.7, 2.3 Hz), 43.5 (t, *J* = 19.9 Hz), 61.8, 127.6 (t, *J* = 307.5 Hz), 128.5, 129.6, 130.0, 133.2, 166.4. ^{19}F (282 MHz, $CDCl_3$), δ: –49.3 (dd, 1F, *J* = 156.6, 8.5 Hz), –48.5 (dd, 1F, *J* = 156.6, 9.4 Hz). HRMS (ESI): Calcd for $C_{12}H_{13}BrF_2O_2Na$ $[M + Na]^+$: 328.9959. Found: 328.9963.

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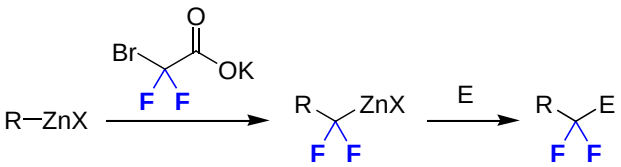

Reactions of organozinc reagents with potassium bromodifluoroacetate

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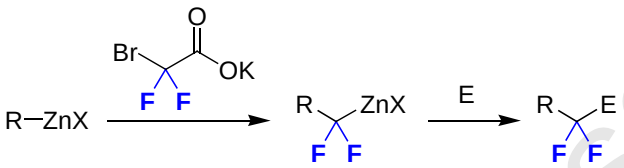

Assembling of *gem*-difluorinated compounds from organozinc reagents, potassium bromodifluoroacetate and electrophiles is described.

Synthesis of *gem*-difluorinated compounds.

Preparation and reactions of fluorinated organozinc reagents.

Reactions of potassium boromodifluoroacetate.