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Synthesis of Difluoromethyl-Containing α-Acyloxycarboxamide Derivatives through a Passerini Reaction and Desulfonylation

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A series of difluoromethyl-containing α-acyloxycarboxamide derivatives were synthesized through a Passerini reaction of acids, aldehydes, and phenylsulfanyl-protected difluorinated isocyanide followed by *meta*-chloroperoxybenzoic acid mediated oxidation and the removal of the phenylsulfonyl protecting group. The unexpected formation of deacylation products from the reaction between the Passerini products and Bu_3SnH/azobis(isobutyronitrile) was also reported.

Introduction

The α-acyloxycarboxamide group is a functional motif which is found in many natural products and bioactive compounds.[1] For example, azinomycins, which are natural products isolated from *Streptomyces griseofuscus*, can be used as antitumor agents.[2] Compound **I** exhibits inhibitory activity for the RNase H function of HIV-1 reverse transcriptase,[3] and compound **II** is reported to have herbicidal activity (Figure 1).[4]

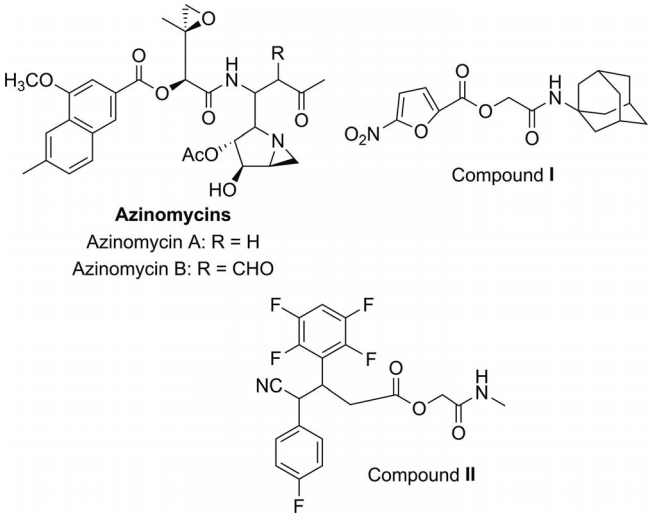
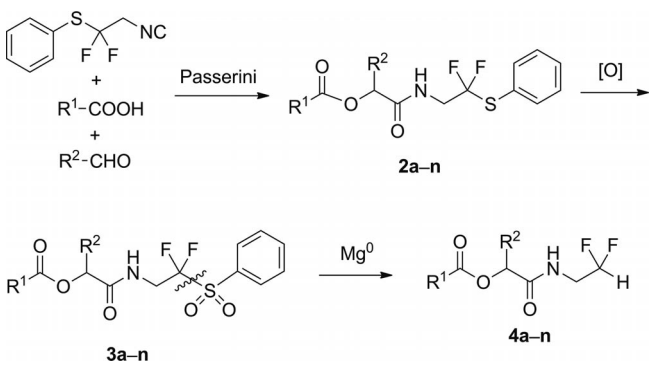


Figure 1. Examples of α-acyloxycarboxamide-containing drugs and agrochemicals.

The modification of molecules by the incorporation of fluorine-containing groups is widely used in drug discovery to alter the chemical, physical, and biological properties of the parent compounds.[5] A survey of the literature indicates that only a few examples of the synthesis of fluorinated α-acyloxycarboxamides are reported, and furthermore, most of these examples involve trifluoromethyl-containing compounds. Gulevich used trifluoromethyl-containing carbonyl compounds as one of the components to prepare trifluoromethyl α-acyloxycarboxamides through a Passerini reaction. These trifluoromethyl-containing Passerini products could be further transformed into trifluoromethyl depsipeptides for bioactivity screening.[6a] Burger synthesized the trifluoromethyl-containing α-acyloxycarboxamides through a Passerini reaction of acids, aldehydes, and 2-isocyano-3,3,3-trifluoropropionate.[6b]

Recently, the introduction of the difluoromethyl group ($-CF_2H$) into biologically active compounds[7] has attracted much interest because of the unique physiological properties of this group.[8] However, up until now, there has been no investigation concerning the synthesis of difluoromethyl α-acyloxycarboxamides. In continuation of our interest in



Scheme 1. Synthesis of difluoromethyl-containing α-acyloxycarboxamides through a Passerini reaction and desulfonylation.

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the synthesis of new difluoromethyl compounds,[9] we intend to prepare difluoromethyl α-acyloxycarboxamides for bioactivity screening. Herein, we describe a new approach for the synthesis of difluoromethyl-containing α-acyloxycarboxamides through a Passerini reaction followed by (*m*-CPBA) *meta*-chloroperoxybenzoic acid mediated oxidation and the removal of the phenylsulfonyl group (Scheme 1).

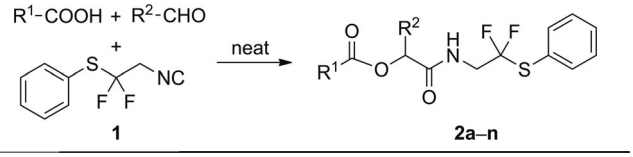
Results and Discussion

Recently, we reported a general synthetic methodology for the construction of functionalized, small molecules bearing a terminal CF_2H group.[10] A new difluoromethylene-containing building block, phenylsulfanyl-protected isocyanide **1**, was designed and used in the Ugi reaction for the synthesis of difluoromethyl-containing pseudopeptides.[10a] Considering the Passerini reaction involves the reaction of aldehydes, carboxylic acids, and isocyanides and is the most efficient method for the preparation of α-acyloxycarboxamides,[11] we used difluorinated isocyanide **1** as one component in a Passerini reaction to synthesize the difluoromethyl-containing α-acyloxycarboxamides. Thus, experiments using several different aldehydes, acids, and isocyanide **1** were carried out under solvent-free conditions (Table 1). To our delight, the reactions proceeded smoothly to give difluoromethylene compounds **2a**–**n** in moderate to high yields. Aldehydes with electron-withdrawing groups attached to the aromatic ring afforded the Passerini products in higher yields and were, therefore, preferable for use in the reactions.

Generally, the Bu_3SnH/AIBN [azobis(isobutyronitrile)] system could be used to remove the PhS moiety from the difluoromethylene compounds to afford the difluomethyl compounds.[12] Hence, we carried out the desulfanylation reaction of compound **2a** in the presence of 3 equiv. of Bu_3SnH and a catalytic amount of AIBN in refluxing toluene. Much to our surprise, the unexpected deacylation compound **5a** was obtained as a major product accompanied by a small amount of the desired desulfanylated product **4a** in a ratio of 9:1 (Scheme 2). However, in a survey of the literature, there is no report of the deacylation of an ester with Bu_3SnH. In addition, it was reported that the ester group remained intact, when Bu_3SnH was used to remove the PhS group in a phenylsulfanyl-containing ester.[12c]

Subsequently, we selected Passerini products **2b**–**g** to undergo the deacylation reaction to further examine the influence of R^1 and R^2 on the formation of the deacylation compounds (Table 2). The results indicate that the substituents (R^1 and R^2) in Passerini products **2a**–**g** have a profound effect on the cleavage of the C–S or C–O bond. However, at the present stage, the effects could not be generalized,

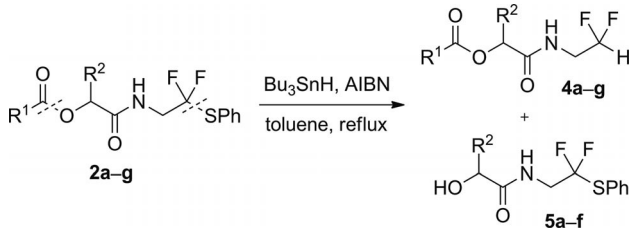
Table 1. Synthesis of α-acyloxycarboxamides **2a**–**n** bearing a CF_2 unit through a Passerini reaction.[a]



Entry	Compd.	R^1	R^2	Yield [%][b]
1	**2a**	Ph	Ph	84
2	**2b**	CH_3	Ph	80
3	**2c**	Ph	4-$CH_3C_6H_4$	74
4	**2d**	Ph	3,4-$(CH_3O)_2C_6H_3$	72
5	**2e**	Ph	4-FC_6H_4	92
6	**2f**	Ph	2,3-$F_2C_6H_3$	91
7	**2g**	Ph	3-F-4-$CF_3C_6H_3$	92
8	**2h**	Ph	$PhCH_2$	78
9	**2i**	Ph	4-$CH_3OC_6H_4$	73
10	**2j**	Ph	3-F-2-$CH_3C_6H_3$	90
11	**2k**	Ph	2-$CH_3C_6H_4$	75
12	**2l**	Ph	3-BrC_6H_4	80
13	**2m**	CH_3	4-$CH_3C_6H_4$	78
14	**2n**	CH_3	4-FC_6H_4	91

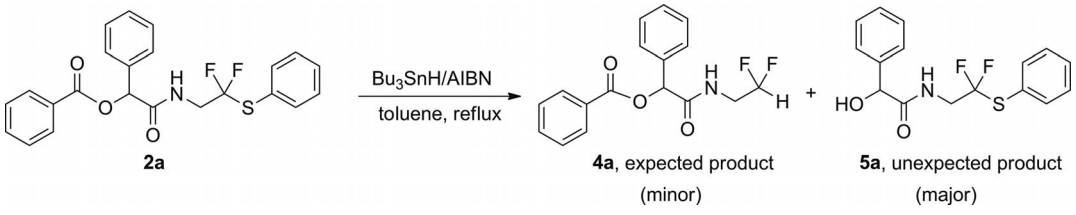
[a] Reagents and conditions: acid (1 mmol), aldehyde (1 mmol), **1** (1 mmol), neat, room temp. [b] Isolated yield.

Table 2. Reaction of Passerini products **2a**–**g** with Bu_3SnH/AIBN.[a]



Entry	Compd.	R^1	R^2	Time [h]	Yield [%][b] 4	5
1	**2a**	Ph	Ph	16	7	83 (**5a**)
2	**2b**	CH_3	Ph	16	8	67 (**5a**)
3	**2c**	Ph	4-$CH_3C_6H_4$	17	10	68 (**5b**)
4	**2d**	Ph	3,4-$(CH_3O)_2C_6H_3$	18	18	57 (**5c**)
5	**2e**	Ph	4-FC_6H_4	7	81	trace (**5d**)
6	**2f**	Ph	2,3-$F_2C_6H_3$	8	83	trace (**5e**)
7	**2g**	Ph	3-F-4-$CF_3C_6H_3$	8	85	trace (**5f**)

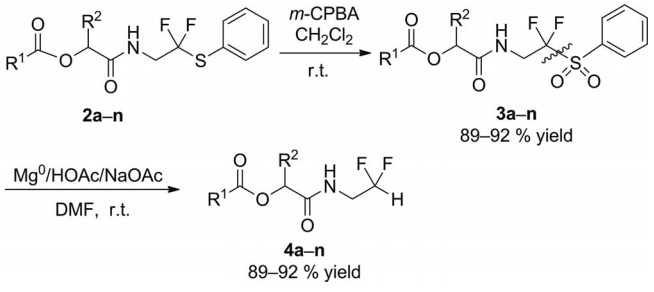
[a] Reagents and conditions: **2a**–**g** (0.5 mmol), Bu_3SnH (1.5 mmol), AIBN (10 mol-%), toluene, reflux. [b] Isolated yield.



Scheme 2. Reaction of Passerini product **2a** with Bu_3SnH/AIBN.

except that the presence of electron-withdrawing groups on the aromatic ring (R^2) were unfavorable for the deacylation reaction and afforded desulfanylated products **4e**–**g** in good yields. Further investigations into the deacylating capacity of Bu_3SnH with different substrates and the mechanism of this reaction are in progress and will be reported in due course.

As the PhS moiety in some of the difluoromethylene Passerini products **2** could not be efficiently removed by Bu_3SnH/AIBN to afford the corresponding difluoromethyl compounds, we turned our efforts to find another synthetic route to the desired compounds. Based on the literature, difluorinated sulfones, sulfoxides, and sulfides can be used as efficient fluoroalkylating reagents to prepare difluoromethyl compounds, which then undergo cleavage of the sulfur-based functionalities.[13] Accordingly, we assumed that the phenylsulfonyl group could be used as the protecting group instead of phenylsulfanyl group to obtain the difluoromethyl compounds. Generally, desulfonylation reactions proceed with reducing agents such as Na/Hg amalgam,[14] SmI_2/HMPA (hexamethylphosphoramide),[15] Mg/$HgCl_2$,[16] and Mg/HOAc/NaOAc.[17] Moreover, the phenylsulfonyl-containing compounds can be conveniently prepared by the oxidation of phenylsulfanyl-containing compounds with *m*-chloroperbenzonic acid (*m*-CPBA).[18] Hence, to overcome the drawbacks in the cleavage of some of the above-mentioned Passerini products with Bu_3SnH, we used *m*-CPBA to oxidize **2a**–**n** to phenylsulfonyl difluoromethylene derivatives **3a**–**n**. Among the reducing agents used for a desulfonylation reaction, reports show that Mg/HOAc/NaOAc is an environmentally benign reaction system.[17] Consequently, we removed the phenylsulfonyl group from **3a**–**n** by employing the reducing agent Mg/HOAc/NaOAc. Thus, we finally obtained the difluoromethyl products **4a**–**n** successfully in high to excellent yields through this new and efficient approach (Scheme 3).



Scheme 3. Synthesis of α-acyloxycarboxamides **4a**–**n** containing a CF_2H group from difluorinated Passerini products **2a**–**n**.

Conclusions

In conclusion, we have reported a new and efficient approach to the synthesis of difluoromethyl-containing α-acyloxycarboxamide derivatives through a Passerini reaction followed by *m*-CPBA-mediated oxidation and removal of the phenylsulfonyl group. In addition, we disclosed an unexpected deacylation reaction with Bu_3SnH/AIBN for some of the Passerini products. It might be a potentially new alternative for the cleavage of the C(O)–O single bond in an ester group.

Experimental Section

General Methods: All reagents were of analytic grade, obtained from commercial suppliers, and used without further purification. Melting points were measured in an open capillary with a Büchi melting point B-540 apparatus. ^1H NMR and ^{13}C NMR spectroscopic data were recorded with a Bruker AM-400 spectrometer using TMS as an internal standard. The ^{19}F NMR spectroscopic data were recorded with a Bruker AM-400 spectrometer, and the ^{19}F NMR were measured with external CF_3CO_2H as the standard. High-resolution mass spectra (ESI) were recorded with a Micro-Mass LCTTM spectrometer. Column chromatography was carried out with Merck silica gel 60 (230–400 mesh).

Preparation of (1,1-Difluoro-2-isocyanoethyl)(phenyl)sulfane (1): Isocyanide **1** was synthesized according to literature procedures.[10a]

General Procedure for the Synthesis of Compounds 2a–n: Isocyanide **1** (1 mmol) was added to a mixture of aldehyde (1 mmol) and carboxylic acid (1 mmol) at room temp. under solvent-free conditions. The mixture was stirred for 12 to 24 h (TLC). The crude residue was purified by chromatography to give the desired products **2a**–**n**.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-2-oxo-1-phenylethyl Benzoate (2a): White solid (359 mg, 84%); m.p. 98.0–99.4 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.13 (d, J = 7.6 Hz, 2 H), 7.66–7.34 (m, 13 H), 6.61 (s, 1 H), 6.42 (s, 1 H), 3.98–3.84 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.6, 164.9, 136.4, 135.0, 133.8, 130.3, 129.9, 129.3, 129.0, 128.9, 128.7, 128.5, 127.6, 127.5 (t, $^1J_{C,F}$ = 274.9 Hz), 125.6, 75.8, 44.4 (t, $^2J_{C,F}$ = 29.1 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.1 (dt, $J_{F,F}$ = 214.1 Hz, $J_{H,F}$ = 12.4 Hz), –79.7 (dt, $J_{F,F}$ = 214.2 Hz, $J_{H,F}$ = 12.5 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-2-oxo-1-phenylethyl Acetate (2b): White solid (292 mg, 80%); m.p. 88.7–90.0 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 7.6 (d, J = 7.6 Hz, 2 H), 7.47–7.37 (m, 8 H), 6.50 (t, J = 4.4 Hz, 1 H), 6.16 (s, 1 H), 3.94–3.85 (m, 2 H), 2.23 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 168.5, 136.4, 135.0, 130.3, 129.3, 129.2, 128.9, 127.6, 127.5 (t, $^1J_{C,F}$ = 280.0 Hz), 125.6, 75.4, 44.4 (t, $^2J_{C,F}$ = 29.0 Hz), 21.0 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.1 (dt, $J_{F,F}$ = 208.0 Hz, $J_{H,F}$ = 12.4 Hz), –79.8 (dt, $J_{F,F}$ = 208.0 Hz, $J_{H,F}$ = 12.4 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-2-oxo-1-*p*-tolylethyl Benzoate (2c): White solid (326 mg, 74%); m.p. 127.5–128.2 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.14 (d, J = 7.2 Hz, 2 H), 7.65–7.36 (m, 10 H), 7.26–7.24 (m, 2 H), 6.69 (t, J = 6.0 Hz, 1 H), 6.40 (s, 1 H), 3.98–3.85 (m, 2 H), 2.38 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.6, 165.0, 139.2, 136.4, 133.8, 132.1, 130.2, 129.9, 129.6, 129.3, 129.2, 128.7, 127.6, 127.5 (t, $^1J_{C,F}$ = 279.9 Hz), 125.7, 75.8, 44.4 (t, $^2J_{C,F}$ = 29.1 Hz), 21.3 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.3 (t, J = 12.4 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(3,4-dimethoxyphenyl)-2-oxoethyl Benzoate (2d): White solid (351 mg, 72%); m.p. 138.4–139.1 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.7 Hz, 2 H), 7.65–6.89 (m, 11 H), 6.55 (t, J = 5.8 Hz, 1 H), 6.37 (s, 1 H), 4.04–3.81 (m, 2 H), 3.91 (s, 3 H), 3.89 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.7, 165.0, 149.9, 149.3, 136.4, 133.7, 129.8, 129.3, 129.2, 128.9, 128.7, 127.5 (t, $^1J_{C,F}$ = 277.6 Hz), 127.4, 125.6, 120.6, 111.2, 110.8, 75.8, 56.0, 55.9, 44.4 (t, $^2J_{C,F}$ =

29.3 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.3 (t, J = 12.4 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(4-fluorophenyl)-2-oxoethyl Benzoate (2e): White solid (409 mg, 92%); m.p. 119.4–120.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.13 (d, J = 7.3 Hz, 2 H), 7.67–7.09 (m, 12 H), 6.71 (t, J = 5.7 Hz, 1 H), 6.40 (s, 1 H), 4.04–3.81 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.4, 164.8, 163.2 (d, $^{1'}J_{C,F}$ = 248.6 Hz), 136.4, 133.9, 131.0 (d, $^{4'}J_{C,F}$ = 3.3 Hz), 130.3, 129.8, 129.6 (d, $^{3'}J_{C,F}$ = 8.7 Hz), 129.3, 128.9, 128.8, 127.4 (t, $^1J_{C,F}$ = 279.8 Hz), 125.6, 115.9 (d, $^{2'}J_{C,F}$ = 21.9 Hz), 75.1, 44.5 (t, $^2J_{C,F}$ = 29.0 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.4 (td, ^1J = 12.2 Hz, ^2J = 3.9 Hz), –111.9 to –112.0 (m) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(2,3-difluorophenyl)-2-oxo-ethyl Benzoate (2f): White solid (421 mg, 91%); m.p. 111.8–112.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.2 Hz, 2 H), 7.67–7.37 (m, 9 H), 7.26–7.13 (m, 2 H), 6.76 (t, J = 5.9 Hz, 1 H), 6.62 (s, 1 H), 4.05–3.86 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.4, 164.7, 150.6 (dd, $^{1'}J_{C,F}$ = 249.5 Hz, $^{2''}J_{C,F}$ = 12.3 Hz), 149.0 (dd, $^{1''}J_{C,F}$ = 251.6 Hz, $^{2'}J_{C,F}$ = 13.7 Hz), 136.4, 134.0, 130.3, 129.9, 129.3, 128.8, 128.6, 127.4 (t, $^1J_{C,F}$ = 280.1 Hz), 125.6, 125.1, 124.9, 124.8, 118.4 (d, $^{2'''}J_{C,F}$ = 17.0 Hz), 70.3, 44.5 (t, $^2J_{C,F}$ = 29.1 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.5 (t, J = 12.4 Hz), –136.9 to –137.0 (m), –140.7 (dt, ^1J = 20.8 Hz, ^2J = 6.6 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-[3-fluoro-4-(trifluoromethyl)phenyl]-2-oxoethyl Benzoate (2g): White solid (472 mg, 92%); m.p. 162.5–163.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.14 (d, J = 7.5 Hz, 2 H), 7.71–7.37 (m, 11 H), 6.71 (t, J = 5.6 Hz, 1 H), 6.44 (s, 1 H), 4.03–3.84 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.3, 164.4, 161.1, 141.6 (d, $^{3'}J_{C,F}$ = 8.5 Hz), 136.3, 134.3, 130.4, 129.9, 129.4, 128.9, 128.3, 127.7, 127.6, 127.3, 125.4, 122.9 (d, $^{4'}J_{C,F}$ = 3.9 Hz), 115.8 (d, $^{2'}J_{C,F}$ = 22.1 Hz), 74.3, 44.5 (t, $^2J_{C,F}$ = 28.9 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –61.5 (d, J = 12.5 Hz), –79.6 (q, J = 12.7 Hz), –112.7 to –112.9 (m) ppm.

1-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-oxo-3-phenylpropan-2-yl Benzoate (2h): White solid (344 mg, 78%); m.p. 81.3–82.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.02 (d, J = 7.5 Hz, 2 H), 7.65–7.22 (m, 13 H), 6.36 (t, J = 5.7 Hz, 1 H), 5.72 (t, J = 5.8 Hz, 1 H), 3.89–3.79 (m, 2 H), 3.42–3.32 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.3, 165.1, 136.3, 135.6, 133.8, 130.2, 129.8, 129.7, 129.3, 129.0, 128.7, 128.5, 127.3 (t, $^1J_{C,F}$ = 278.5 Hz), 127.1, 125.7, 74.7, 44.3 (t, $^2J_{C,F}$ = 29.1 Hz), 37.7 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.1 (dt, $J_{F,F}$ = 208.0 Hz, $J_{H,F}$ = 9.5 Hz), –79.7 (dt, $J_{F,F}$ = 213.6 Hz, $J_{H,F}$ = 9.8 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(4-methoxyphenyl)-2-oxoethyl Benzoate (2i): White solid (334 mg, 73%); m.p. 109.7–110.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.2 Hz, 2 H), 7.65–7.36 (m, 10 H), 6.96–6.94 (m, 2 H), 6.66 (t, J = 6.0 Hz, 1 H), 6.38 (s, 1 H), 3.99–3.83 (m, 2 H), 3.82 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.6, 165.0, 160.3, 136.4, 133.7, 130.3, 129.9, 129.3, 129.2, 129.1, 128.7, 127.5 (t, $^1J_{C,F}$ = 279.9 Hz), 127.2, 125.6, 114.3, 75.6, 55.3, 44.4 (t, $^2J_{C,F}$ = 29.0 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.5 (td, ^1J = 12.4 Hz, ^2J = 2.0 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(3-fluoro-2-methylphenyl)-2-oxoethyl Benzoate (2j): White solid (413 mg, 90%); m.p. 97.9- 98.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.2 Hz, 2 H), 7.67–7.37 (m, 8 H), 7.31–7.20 (m, 2 H), 7.10–7.05 (m, 1 H), 6.63 (s, 1 H), 6.59 (t, J = 5.8 Hz, 1 H), 4.04–3.83 (m, 2 H), 2.47 (d, J = 1.9 Hz, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.3, 164.7, 161.4 (d, $^{1'}J_{C,F}$ = 244.8 Hz), 136.4, 136.0 (d, $^{3''}J_{C,F}$ = 4.1 Hz), 133.9, 130.3, 129.9, 129.4, 128.9, 128.8, 127.4 (t, $^1J_{C,F}$ = 280.1 Hz), 127.3 (d, $^{3'}J_{C,F}$ = 8.9 Hz), 125.6, 124.9 (d, $^{2''}J_{C,F}$ = 17.4 Hz), 123.6 (d, $^{4'}J_{C,F}$ = 3.2 Hz), 116.1 (d, $^{2'}J_{C,F}$ = 23.4 Hz), 73.1(d, $^{4''}J_{C,F}$ = 3.1 Hz), 44.4 (t, $^2J_{C,F}$ = 28.9 Hz), 10.8 (d, $^{3'''}J_{C,F}$ = 5.8 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.5 (q, J = 12.1 Hz), –114.8 to –114.9 (m) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-2-oxo-1-*o*-tolylethyl Benzoate (2k): White solid (331 mg, 75%); m.p. 86.3–87.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.15 (d, J = 7.7 Hz, 2 H), 7.65–7.27 (m, 12 H), 6.74 (t, J = 6.0 Hz, 1 H), 6.69 (s, 1 H), 4.01–3.86 (m, 2 H), 2.60 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.9, 166.0, 137.4, 136.4, 133.8, 131.2, 130.3, 130.1, 129.9, 129.4, 129.1, 128.7, 128.5, 128.2, 127.6 (t, $^1J_{C,F}$ = 280.1 Hz), 126.5, 125.7, 73.7, 44.5 (t, $^2J_{C,F}$ = 28.8 Hz), 19.6 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.0 to –79.2 (m) ppm.

1-(3-Bromophenyl)-2-[2,2-difluoro-2-(phenylthio)ethylamino]-2-oxoethyl Benzoate (2l): White solid (405 mg, 80%); m.p. 84.3–85.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.14 (d, J = 7.6 Hz, 2 H), 7.76–7.29 (m, 12 H), 6.75 (t, J = 6.0 Hz, 1 H), 6.38 (s, 1 H), 4.00–3.82 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.1, 164.7, 137.2, 136.9, 136.4, 134.0, 132.4, 130.5, 130.4, 129.9, 129.3, 128.8, 128.7, 127.5 (t, $^1J_{C,F}$ = 280.6 Hz), 126.3, 125.6, 122.9, 74.9, 44.5 (t, $^2J_{C,F}$ = 29.2 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –78.9 (dt, $J_{F,F}$ = 208.2 Hz, $J_{H,F}$ = 12.2 Hz), –79.5 (dt, $J_{F,F}$ = 208.2 Hz, $J_{H,F}$ = 9.8 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-2-oxo-1-*p*-tolylethyl Acetate (2m): White solid (295 mg, 78%); m.p. 96.4–97.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.59 (d, J = 7.5 Hz, 2 H), 7.48–7.20 (m, 7 H), 6.53 (t, J = 6.0 Hz, 1 H), 6.13 (s, 1 H), 3.93–3.84 (m, 2 H), 2.37 (s, 3 H), 2.20 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 168.7, 139.2, 136.4, 132.1, 130.2, 129.5, 129.3, 127.6, 127.5 (t, $^1J_{C,F}$ = 282.5 Hz), 125.7, 75.3, 44.4 (t, $^2J_{C,F}$ = 29.0 Hz), 21.2, 21.0 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.0 (dt, $J_{F,F}$ = 208.4 Hz, $J_{H,F}$ = 12.3 Hz), –79.6 (dt, $J_{F,F}$ = 208.4 Hz, $J_{H,F}$ = 12.3 Hz) ppm.

2-[2,2-Difluoro-2-(phenylthio)ethylamino]-1-(4-fluorophenyl)-2-oxoeth-yl Acetate (2n): White solid (348 mg, 91%); m.p. 72.9–74.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.57 (d, J = 7.5 Hz, 2 H), 7.49–7.05 (m, 7 H), 6.79 (t, J = 6.0 Hz, 1 H), 6.14 (s, 1 H), 3.92–3.83 (m, 2 H), 2.19 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 168.6, 163.1 (d, $^{1'}J_{C,F}$ = 248.5 Hz), 136.4, 131.1 (d, $^{4'}J_{C,F}$ = 3.2 Hz), 130.3, 129.6 (d, $^{3'}J_{C,F}$ = 8.5 Hz), 129.3, 127.4 (t, $^1J_{C,F}$ = 271.1 Hz), 125.6, 115.8 (d, $^{2'}J_{C,F}$ = 21.8 Hz), 74.7, 44.5 (t, $^2J_{C,F}$ = 28.8 Hz), 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.3 (td, ^1J = 12.5 Hz, ^2J = 4.4 Hz), –111.9 to –112.0 (m) ppm.

General Procedure for the Synthesis of Compounds 3a–n: To a solution of Passerini products **2a**–**n** (0.7 mmol) in CH_2Cl_2 was added *m*-CPBA (2.1 mmol) at 0 °C. The ice bath was removed, and the reaction mixture was stirred at room temp. for 24–48 h (TLC). A saturated aqueous solution of $Na_2S_2O_3$ was added to quench the reaction. The layers were separated, and the aqueous phase was extracted with CH_2Cl_2. The combined organic phases were washed with saturated $NaHCO_3$ and brine, dried with Na_2SO_4, filtered, and concentrated to get the crude product which was purified by chromatography to afford products **3a**–**n**.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-2-oxo-1-phenylethyl Benzoate (3a): White solid (289 mg, 90%); m.p. 126.1–127.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.19 (d, J = 7.8 Hz, 2 H), 7.96–7.38 (m, 13 H), 7.08 (t, J = 5.5 Hz, 1 H), 6.43 (s, 1 H), 4.36–4.26 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.9, 164.7, 136.0, 135.1, 133.8, 131.4, 130.8, 130.0, 129.6, 129.3, 128.9, 128.7, 127.4, 124.9, 120.2 (t, $^1J_{C,F}$ = 289.7 Hz), 75.8, 38.4 (t, $^2J_{C,F}$ =

25.9 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.7 (t, J = 12.4 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-2-oxo-1-phenylethyl Acetate (3b): White solid (253 mg, 91%.); m.p. 107.8–108.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.98 (d, J = 7.7 Hz, 2 H), 7.84–7.39 (m, 8 H), 6.91 (t, J = 5.6 Hz, 1 H), 6.19 (s, 1 H), 4.38–4.15 (m, 2 H), 2.25 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 168.9, 135.9, 134.9, 131.6, 130.8, 129.6, 129.2, 128.8, 127.4, 120.2 (t, $^1J_{C,F}$ = 288.7 Hz), 75.3, 38.4 (t, $^2J_{C,F}$ = 25.9 Hz), 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.0 (dt, $J_{F,F}$ = 235.1 Hz, $J_{H,F}$ = 11.7 Hz), –108.2 (dt, $J_{F,F}$ = 235.1 Hz, $J_{H,F}$ = 13.2 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-2-oxo-1-*p*-tolylethyl Benzoate (3c): White solid (301 mg, 91%.); m.p. 84.8–85.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.18 (d, J = 7.5 Hz, 2 H), 7.96–7.22 (m, 12 H), 7.07 (t, J = 6.0 Hz, 1 H), 6.40 (s, 1 H), 4.34–4.25 (m, 2 H), 2.37 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 164.8, 139.2, 135.9, 133.7, 132.2, 131.6, 130.7, 130.0, 129.6, 129.5, 129.1, 128.6, 127.4, 120.3 (t, $^1J_{C,F}$ = 289.9 Hz), 75.8, 38.4 (t, $^2J_{C,F}$ = 25.3 Hz), 21.3 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.6 (td, ^1J = 12.8 Hz, ^2J = 2.2 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(3,4-dimethoxyphenyl)-2-oxoethyl Benzoate (3d): White solid (327 mg, 90%); m.p. 121.3–122.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.17–8.15 (m, 2 H), 7.95–7.09 (m, 10 H), 7.05 (t, J = 6.2 Hz, 1 H), 6.90–6.88 (m, 1 H), 6.37 (s, 1 H), 4.42–4.19 (m, 2 H), 3.91 (s, 3 H), 3.89 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 164.9, 149.9, 149.3, 136.0, 133.7, 131.6, 130.7, 129.9, 129.6, 129.1, 128.6, 127.5, 120.5, 120.3 (t, $^1J_{C,F}$ = 290.4 Hz), 111.2, 110.7, 75.7, 56.0, 55.9, 38.5 (t, $^2J_{C,F}$ = 25.7 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.1 (dt, $J_{F,F}$ = 235.5 Hz, $J_{H,F}$ = 12.4 Hz), –107.8 (dt, $J_{F,F}$ = 235.5 Hz, $J_{H,F}$ = 12.5 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(4-fluorophenyl)-2-oxoethyl Benzoate (3e): White solid (307 mg, 92%); m.p. 125.1–126.6 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.17 (d, J = 7.5 Hz, 2 H), 7.96–7.49 (m, 10 H), 7.13–709 (m, 3 H), 6.41 (s, 1 H), 4.36–4.25(m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.8, 164.7, 163.2 (d, $^{1'}J_{C,F}$ = 248.5 Hz), 136.0, 133.9, 131.5, 131.1, 130.7, 129.9, 129.6, 129.4 (d, $^{3'}J_{C,F}$ = 8.5 Hz), 128.8, 128.7, 120.3 (t, $^1J_{C,F}$ = 289.8 Hz), 115.9 (d, $^{2'}J_{C,F}$ = 21.8 Hz), 75.1, 38.5 (t, $^2J_{C,F}$ = 25.6 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.2 (dt, $J_{F,F}$ = 235.3 Hz, $J_{H,F}$ = 12.4 Hz), –107.9 (dt, $J_{F,F}$ = 235.2 Hz, $J_{H,F}$ = 12.4 Hz), –112.0 to –112.1 (m) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(2,3-difluorophenyl)-2-oxoethyl Benzoate (3f): White solid (315 mg, 91%); m.p. 137.7–139.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.16 (d, J = 7.2 Hz, 2 H), 7.99–7.49 (m, 8 H), 7.35 (t, J = 7.0 Hz, 1 H), 7.25–7.12 (m, 3 H), 6.63 (s, 1 H), 4.45–4.22 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.8, 164.6, 150.6 (dd, $^{1'}J_{C,F}$ = 249.4 Hz, $^{2''}J_{C,F}$ = 12.4 Hz), 149.1 (dd, $^{1''}J_{C,F}$ = 251.4 Hz, $^{2'}J_{C,F}$ = 13.0 Hz), 136.0, 134.0, 131.6, 130.8, 130.0, 129.6, 128.7, 128.6, 125.1 (d, $^{3'}J_{C,F}$ = 10.5 Hz), 124.8, 124.5, 120.2 (t, $^1J_{C,F}$ = 291.0 Hz), 118.4 (d, $^{2'}J_{C,F}$ = 17.1 Hz), 70.4, 38.5 (t, $^2J_{C,F}$ = 25.6 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.1 (dt, $J_{F,F}$ = 234.9 Hz, $J_{H,F}$ = 12.8 Hz), –108.0 (dt, $J_{F,F}$ = 234.6 Hz, $J_{H,F}$ = 12.9 Hz), –136.9 to –137.0 (m), –140.6 (d, J = 20.7 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-[3-fluoro-4-(trifluoromethyl)phenyl]-2-oxoethyl Benzoate (3g): White solid (339 mg, 89%); m.p. 117.6–118.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.20 (d, J = 7.6 Hz, 2 H), 7.97–7.45 (m, 11 H), 7.24 (t, J = 5.9 Hz, 1 H), 6.44 (s, 1 H), 4.42–4.22 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.7, 164.4, 161.1, 141.7 (d, $^{3'}J_{C,F}$ = 7.0 Hz), 136.1, 134.2, 131.3, 130.7, 130.0, 129.6, 128.9, 128.3, 127.7, 127.6, 123.0 (d, $^{4'}J_{C,F}$ = 3.8 Hz), 120.2 (t, $^1J_{C,F}$ = 258.3 Hz), 115.7 (d, $^{2'}J_{C,F}$ = 22.0 Hz), 74.3, 38.6 (t, $^2J_{C,F}$ = 26.3 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –61.5 (d, J = 12.6 Hz), –107.1 (dt, $J_{F,F}$ = 235.7 Hz, $J_{H,F}$ = 12.3 Hz), –107.9 (dt, $J_{F,F}$ = 235.7 Hz, $J_{H,F}$ = 12.6 Hz), –112.7 to –112.9 (m) ppm.

1-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-oxo-3-phenylpropan-2-yl Benzoate (3h): White solid (301 mg, 91%); m.p. 60.1–61.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.05–8.03 (m, 2 H), 7.89–7.22 (m, 13 H), 6.96 (t, J = 6.3 Hz, 1 H), 5.72 (dd, ^1J = 6.6 Hz, ^2J = 5.0 Hz, 1 H),4.24–4.10 (m, 2 H), 3.41–3.30 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.9, 165.2, 135.9, 135.7, 133.7, 131.6, 130.7, 129.8, 129.7, 129.5, 129.0, 128.6, 128.5, 127.0, 120.4 (t, $^1J_{C,F}$ = 289.8 Hz), 74.7, 38.1 (t, $^2J_{C,F}$ = 24.4 Hz), 37.8 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.1 (td, ^1J = 13.5 Hz, ^2J = 4.3 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(4-methoxyphenyl)-2-oxoethyl Benzoate (3i): White solid (305 mg, 89%); m.p. 140.3–141.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.16 (d, J = 7.8 Hz, 2 H), 7.95–7.47 (m, 10 H), 7.11 (t, J = 6.1 Hz, 1 H), 6.95–6.93 (m, 2 H), 6.38 (s, 1 H), 4.35–4.23 (m, 2 H), 3.81 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.3, 164.9, 160.3, 135.9, 133.7, 131.6, 130.7, 129.9, 129.6, 129.1, 129.0, 128.6, 127.3, 120.4 (t, $^1J_{C,F}$ = 289.8 Hz), 114.3, 75.6, 55.3, 38.4 (t, $^2J_{C,F}$ = 25.1 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.2 (dt, $J_{F,F}$ = 233.8 Hz, $J_{H,F}$ = 12.3 Hz), –107.9 (dt, $J_{F,F}$ = 227.8 Hz, $J_{H,F}$ = 12.9 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(3-fluoro-2-methylphenyl)-2-oxoethyl Benzoate (3j): White solid (309 mg, 90%); m.p. 142.5–143.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.18–8.15 (m, 2 H), 7.97–7.19 (m, 10 H), 7.13 (t, J = 6.1 Hz, 1 H), 7.08–7.04 (m, 1 H), 6.65 (s, 1 H), 4.39–4.24 (m, 2 H), 2.48 (d, J = 1.9 Hz, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.7, 164.7, 161.4 (d, $^{1'}J_{C,F}$ = 244.5 Hz), 136.2 (d, $^{3''}J_{C,F}$ = 4.2 Hz), 136.0, 133.9, 131.5, 130.7, 129.9, 129.6, 128.8, 128.7, 127.3 (d, $^{3'}J_{C,F}$ = 8.9 Hz), 124.9 (d, $^{2''}J_{C,F}$ = 17.6 Hz), 123.4 (d, $^{4'}J_{C,F}$ = 3.4 Hz), 120.3 (t, $^1J_{C,F}$ = 290.6 Hz), 116.0 (d, $^{2'}J_{C,F}$ = 23.4 Hz), 73.0 (d, $^{4''}J_{C,F}$ = 2.9 Hz), 38.4 (t, $^2J_{C,F}$ = 25.5 Hz), 10.7 (d, $^{3'''}J_{C,F}$ = 5.7 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.0 (dt, $J_{F,F}$ = 234.8 Hz, $J_{H,F}$ = 12.1 Hz), –108.0 (dt, $J_{F,F}$ = 234.7 Hz, $J_{H,F}$ = 12.7 Hz), –115.0 to –115.1 (m) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-2-oxo-1-*o*-tolylethyl Benzoate (3k): White solid (295 mg, 89%); m.p. 143.8–144.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.17 (d, J = 7.6 Hz, 2 H), 7.97–7.25 (m, 12 H), 7.04 (t, J = 5.9 Hz, 1 H), 6.66 (s, 1 H), 4.38–4.24 (m, 2 H), 2.59 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 164.8, 137.3, 136.0, 133.8, 133.7, 131.6, 131.1, 130.8, 129.9, 129.6, 129.3, 129.0, 128.7, 127.7, 126.4, 120.3 (t, $^1J_{C,F}$ = 290.1 Hz), 73.4, 38.4 (t, $^2J_{C,F}$ = 25.3 Hz), 19.6 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.1 (dt, $J_{F,F}$ = 235.6 Hz, $J_{H,F}$ = 12.7 Hz), –107.9 (dt, $J_{F,F}$ = 235.3 Hz, $J_{H,F}$ = 12.4 Hz) ppm.

1-(3-Bromophenyl)-2-[2,2-difluoro-2-(phenylsulfonyl)ethylamino]-2-oxoethyl Benzoate (3l): White solid (339 mg, 90%); m.p. 136.2–137.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.18 (d, J = 7.3 Hz, 2 H), 7.97–7.19 (m, 12 H), 7.18 (t, J = 6.1 Hz, 1 H), 6.38 (s, 1 H), 4.35–4.22 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.4, 164.6, 137.3, 136.0, 134.0, 132.4, 131.5, 130.8, 130.4, 130.3, 130.0, 129.6, 128.8, 128.7, 126.2, 122.8, 120.2 (t, $^1J_{C,F}$ = 290.1 Hz), 75.0, 38.5 (t, $^2J_{C,F}$ = 25.8 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.2 (dt, $J_{F,F}$ = 235.6 Hz, $J_{H,F}$ = 12.4 Hz), –107.9 (dt, $J_{F,F}$ = 235.7 Hz, $J_{H,F}$ = 12.4 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-2-oxo-1-*p*-tolylethyl Acetate (3m): White solid (259 mg, 90%); m.p. 130.3–131.0 °C. ^{1}H

NMR (400 MHz, $CDCl_3$): δ = 7.98 (d, J = 7.9 Hz, 2 H), 7.84–7.20 (m, 7 H), 6.90 (t, J = 5.8 Hz, 1 H), 6.15 (s, 1 H), 4.33–4.18 (m, 2 H), 2.37 (s, 3 H), 2.23 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.2, 169.1, 139.2, 136.0, 132.0, 131.6, 130.8, 129.6, 129.5, 127.4, 120.3 (t, $^1J_{C,F}$ = 281.1 Hz), 75.2, 38.4 (t, $^2J_{C,F}$ = 25.3 Hz), 21.2, 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.1 (dt, $J_{F,F}$ = 234.9 Hz, $J_{H,F}$ = 12.3 Hz), –107.9 (dt, $J_{F,F}$ = 234.7 Hz, $J_{H,F}$ = 12.2 Hz) ppm.

2-[2,2-Difluoro-2-(phenylsulfonyl)ethylamino]-1-(4-fluorophenyl)-2-oxoethyl Acetate (3n): White solid (242 mg, 91%); m.p. 100.1–101.3 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 7.98 (d, J = 7.8 Hz, 2 H), 7.84–7.06 (m, 7 H), 7.00 (t, J = 5.8 Hz, 1 H), 6.16 (s, 1 H), 4.33–4.18 (m, 2 H), 2.24 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 168.8, 163.1 (d, $^{1'}J_{C,F}$ = 248.3 Hz), 136.0, 131.5, 130.9 (d, $^{4'}J_{C,F}$ = 3.1 Hz), 130.7, 129.6, 129.4 (d, $^{3'}J_{C,F}$ = 8.6 Hz), 120.2 (t, $^1J_{C,F}$ = 289.7 Hz), 115.8 (d, $^{2'}J_{C,F}$ = 21.8 Hz), 74.6, 38.4 (t, $^2J_{C,F}$ = 25.6 Hz), 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –107.1 (dt, $J_{F,F}$ = 234.5 Hz, $J_{H,F}$ = 12.3 Hz), –108.0 (dt, $J_{F,F}$ = 235.1 Hz, $J_{H,F}$ = 12.6 Hz) ppm.

General Procedure for the Synthesis of Compounds 4a–n: A buffer solution (8 M) of HOAc/NaOAc (1:1, 4 mL) was added to sulfone compounds **3a**–**n** (0.5 mmol) in DMF (dimethylformamide) at room temp. Magnesium turnings (7.5 mmol) were added in portions. The reaction mixture was stirred for 3–6 h (TLC), and then water was added. The solution was extracted with Et_2O, and the combined organic phases were washed with a saturated solution of $NaHCO_3$ and brine and then dried with Na_2SO_4. After the removal of solvent, the crude product was purified by silica gel column chromatography to give products **4a**–**n**.

2-(2,2-Difluoroethylamino)-2-oxo-1-phenylethyl Benzoate (4a): White solid (145 mg, 91%); m.p. 118.0–119.2 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.8 Hz, 2 H), 7.66–7.39 (m, 8 H), 6.51 (t, J = 6.0 Hz, 1 H), 6.39 (s, 1 H), 5.88 (tt, ^1J = 55.9 Hz, ^2J = 3.8 Hz, 1 H), 3.78–3.64 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 164.4, 160.2, 130.3, 129.0, 125.1, 124.5, 124.3, 124.2, 123.9, 122.6, 108.5 (t, $^1J_{C,F}$ = 241.5 Hz), 71.1, 36.9 (t, $^2J_{C,F}$ = 26.6 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.1 (dt, ^1J = 55.9 Hz, ^2J = 14.7 Hz) ppm. HRMS (ESI): calcd. for $C_{17}H_{14}F_2NO_3$ $[M – H]^+$ 318.0942; found 318.0943.

2-(2,2-Difluoroethylamino)-2-oxo-1-phenylethyl Acetate (4b): White solid (115 mg, 90%); m.p. 102.6–104.0 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 7.46–7.39 (m, 5 H), 6.52 (t, J = 6.0 Hz, 1 H), 6.12 (s, 1 H), 5.88 (tt, ^1J = 55.9 Hz, ^2J = 4.0 Hz, 1 H), 3.72–3.63 (m, 2 H), 2.21 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 169.0, 135.0, 129.3, 128.9, 127.4, 113.3 (t, $^1J_{C,F}$ = 241.4 Hz), 75.4, 41.5 (t, $^2J_{C,F}$ = 26.5 Hz), 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.1 (dt, ^1J = 56.0 Hz, ^2J = 14.6 Hz) ppm. HRMS (ESI): calcd. for $C_{12}H_{12}F_2NO_3$ $[M – H]^+$ 256.0785; found 256.0787.

2-(2,2-Difluoroethylamino)-2-oxo-1-*p*-tolylethyl Benzoate (4c): White solid (150 mg, 90%); m.p. 118.8–120.5 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.11 (d, J = 7.8 Hz, 2 H), 7.65–7.23 (m, 7 H), 6.53 (t, J = 6.0 Hz, 1 H), 6.34 (s, 1 H), 5.87 (tt, ^1J = 56.0 Hz, ^2J = 4.0 Hz, 1 H), 3.77–3.59 (m, 2 H), 2.38 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.4, 165.0, 139.3, 133.8, 132.1, 129.9, 129.7, 129.1, 128.7, 127.4, 113.3 (t, $^1J_{C,F}$ = 241.7 Hz), 75.7, 41.6 (t, $^2J_{C,F}$ = 26.7 Hz), 21.2 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dt, ^1J = 56.0 Hz, ^2J = 14.6 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{16}F_2NO_3$ $[M – H]^+$ 332.1098; found 332.1095.

2-(2,2-Difluoroethylamino)-1-(3,4-dimethoxyphenyl)-2-oxoethyl Benzoate (4d): White solid (169 mg, 89%); m.p. 151.8–152.8 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.10 (d, J = 7.7 Hz, 2 H), 7.65–6.88 (m, 6 H), 6.51 (t, J = 5.8 Hz, 1 H), 6.32 (s, 1 H), 5.89 (tt, ^1J = 55.9 Hz, ^2J = 3.5 Hz, 1 H), 3.91 (s, 3 H), 3.89 (s, 3 H), 3.84–3.62 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.4, 165.1, 149.9, 149.3, 133.8, 129.8, 129.1, 128.7, 127.4, 120.3, 113.3 (t, $^1J_{C,F}$ = 241.5 Hz), 111.2, 110.7, 75.7, 56.0, 55.9, 41.6 (t, $^2J_{C,F}$ = 26.3 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dtd, ^1J = 55.9 Hz, ^2J = 12.5 Hz, ^2J = 4.5 Hz) ppm. HRMS (ESI): calcd. for $C_{19}H_{18}F_2NO_5$ $[M – H]^+$ 378.1153; found 378.1152.

2-(2,2-Difluoroethylamino)-1-(4-fluorophenyl)-2-oxoethyl Benzoate (4e): White solid (150 mg, 89%); m.p. 141.2–142.5 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.10 (d, J = 7.3 Hz, 2 H), 7.67–7.09 (m, 7 H), 6.59 (t, J = 5.7 Hz, 1 H), 6.36 (s, 1 H), 5.89 (tt, ^1J = 55.8 Hz, ^2J = 3.9 Hz, 1 H), 3.79–3.64 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 164.9, 163.2 (d, $^{1'}J_{C,F}$ = 248.6 Hz), 134.0, 130.9 (d, $^{4'}J_{C,F}$ = 3.0 Hz), 129.8, 129.4 (d, $^{3'}J_{C,F}$ = 8.3 Hz), 128.8, 128.7, 116.0 (d, $^{2'}J_{C,F}$ = 21.9 Hz), 113.2 (t, $^1J_{C,F}$ = 241.5 Hz), 75.1, 41.6 (t, $^2J_{C,F}$ = 26.5 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –111.8 to –111.9 (m), –123.0 (dtd, ^1J = 55.8 Hz, ^2J = 13.2 Hz, ^2J = 3.0 Hz) ppm. HRMS (ESI): calcd. for $C_{17}H_{13}F_3NO_3$ $[M – H]^+$ 336.0848; found 336.0845.

2-(2,2-Difluoroethylamino)-1-(3,4-difluorophenyl)-2-oxoethyl Benzoate (4f): White solid (161 mg, 91%); m.p. 109.6–111.3 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.11–8.08 (m, 2 H), 7.67–7.13 (m, 6 H), 6.70 (t, J = 5.9 Hz, 1 H), 6.58 (s, 1 H), 5.91 (tt, ^1J = 55.9 Hz, ^2J = 4.1 Hz, 1 H), 3.83–3.65 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.0, 164.7, 150.6 (dd, $^{1'}J_{C,F}$ = 250.1 Hz, $^{2''}J_{C,F}$ = 13.0 Hz), 149.1 (dd, $^{1''}J_{C,F}$ = 251.2 Hz, $^{2'}J_{C,F}$ = 13.8 Hz), 134.0, 129.9, 128.8, 128.6, 125.0 (d, $^{3''}J_{C,F}$ = 10.3 Hz), 124.8, 124.6 (dd, $^{3'}J_{C,F}$ = 6.7 Hz, $^{4''}J_{C,F}$ = 4.7 Hz), 118.5 (d, $^{2'}J_{C,F}$ = 17.1 Hz), 113.2 (t, $^1J_{C,F}$ = 241.5 Hz), 70.4, 41.7 (t, $^2J_{C,F}$ = 29.1 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.1 (ddd, ^1J = 55.9 Hz, ^2J = 26.5 Hz, ^3J = 14.4 Hz), –136.9 to –137.0 (m), –141.0 (dt, ^1J = 20.7 Hz, ^2J = 6.6 Hz) ppm. HRMS (ESI): calcd. for $C_{17}H_{12}F_4NO_3$ $[M – H]^+$ 354.0753; found 354.0749.

2-(2,2-Difluoroethylamino)-1-[3-fluoro-4-(trifluoromethyl)phenyl]-2-oxoethyl Benzoate (4g): White solid (180 mg, 89%); m.p. 165.9–167.8 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.12 (d, J = 7.4 Hz, 2 H), 7.71–7.38 (m, 6 H), 6.63 (t, J = 5.6 Hz, 1 H), 6.41 (s, 1 H), 5.90 (tt, ^1J = 55.9 Hz, ^2J = 4.0 Hz, 1 H), 3.79–3.65 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 167.9, 164.5, 159.8 (d, $^{1'}J_{C,F}$ = 257.3 Hz), 141.5, 134.3, 129.9, 128.9, 128.3, 127.8, 122.8 (d, $^{4'}J_{C,F}$ = 3.6 Hz), 115.7 (d, $^{2'}J_{C,F}$ = 22.2 Hz), 113.1 (t, $^1J_{C,F}$ = 241.7 Hz), 74.3, 41.7 (t, $^2J_{C,F}$ = 26.1 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –61.6 (d, J = 12.5 Hz), –112.6 to –112.8 (m), –123.2 (dt, ^1J = 55.7 Hz, ^2J = 14.8 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{12}F_6NO_3$ $[M – H]^+$ 404.0721; found 404.0720.

1-(2,2-Difluoroethylamino)-1-oxo-3-phenylpropan-2-yl Benzoate (4h): White solid (150 mg, 90%); m.p. 134.0–135.5 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.01 (d, J = 7.7 Hz, 2 H), 7.64–7.24 (m, 8 H), 6.18 (t, J = 6.3 Hz, 1 H), 5.71 (tt, ^1J = 55.6 Hz, ^2J = 4.2 Hz, 1 H), 5.69 (t, J = 5.5 Hz, 1 H), 3.68–3.51 (m, 2 H), 3.34 (d, J = 5.6 Hz, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.8, 165.1, 135.4, 133.8, 129.8, 129.6, 128.9, 128.7, 128.5, 127.2, 113.3 (t, $^1J_{C,F}$ = 241.8 Hz), 74.6, 41.4 (t, $^2J_{C,F}$ = 26.7 Hz), 37.8 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –121.9 to –123.7 (m) ppm. HRMS (ESI): calcd. for $C_{18}H_{16}F_2NO_3$ $[M – H]^+$ 332.1098; found 332.1096.

2-(2,2-Difluoroethylamino)-1-(4-methoxyphenyl)-2-oxoethyl Benzoate (4i): White solid (161 mg, 92%); m.p. 129.6–130.9 °C. ^1H NMR (400 MHz, $CDCl_3$): δ = 8.10 (d, J = 8.0 Hz, 2 H), 7.65–6.93 (m, 7 H), 6.55 (t, J = 5.5 Hz, 1 H), 6.33 (s, 1 H), 5.88 (tt, ^1J = 55.9 Hz, ^2J = 4.0 Hz, 1 H), 3.83 (s, 3 H), 3.78–3.62 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.5, 165.1, 160.3, 133.7, 129.8, 129.1,

129.0, 128.7, 127.1, 114.4, 113.3 (t, $^1J_{C,F}$ = 241.5 Hz), 75.6, 55.3, 41.6 (t, $^2J_{C,F}$ = 26.6 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dt, ^1J = 56.3 Hz, ^2J = 15.0 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{16}F_2NO_4$ $[M - H]^+$ 348.1047; found 348.1044.

2-(2,2-difluoroethylamino)-1-(3-fluoro-2-methylphenyl)-2-oxoethyl Benzoate (4j): White solid (158 mg, 90%); m.p. 79.4–81.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.10–8.08 (m, 2 H), 7.65–7.05 (m, 6 H), 6.75 (t, J = 5.9 Hz, 1 H), 6.61 (s, 1 H), 5.89 (tt, ^1J = 55.9 Hz, ^2J = 4.0 Hz, 1 H), 3.76–3.60 (m, 2 H), 2.44 (d, J = 2.1 Hz, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 164.9, 161.4 (d, $^{1'}J_{C,F}$ = 244.9 Hz), 136.0 (d, $^{5'}J_{C,F}$ = 4.2 Hz), 133.9, 129.8, 128.7, 128.4, 127.3 (d, $^{3'}J_{C,F}$ = 8.8 Hz), 124.8 (d, $^{2''}J_{C,F}$ = 17.4 Hz), 123.5 (d, $^{4'}J_{C,F}$ = 3.2 Hz), 116.1 (d, $^{2'}J_{C,F}$ = 23.4 Hz), 113.3 (t, $^1J_{C,F}$ = 241.5 Hz), 73.0 (d, $^{4''}J_{C,F}$ = 2.9 Hz), 41.6 (t, $^2J_{C,F}$ = 26.4 Hz), 10.7 (d, $^{3''}J_{C,F}$ = 5.8 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –114.8 to –114.9 (m), –123.0 (dt, J_1 = 55.9 Hz, J_2 = 14.8 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{15}F_3NO_3$ $[M - H]^+$ 350.1004; found 350.1002.

2-(2,2-Difluoroethylamino)-2-oxo-1-*o*-tolylethyl Benzoate (4k): White solid (150 mg, 90%); m.p. 99.1–100.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.10 (d, J = 7.3 Hz, 2 H), 7.65–7.26 (m, 7 H), 6.63 (s, 1 H), 6.50 (t, J = 6.0 Hz, 1 H), 5.89 (tt, ^1J = 55.9 Hz, ^2J = 4.0 Hz, 1 H), 3.78–3.63 (m, 2 H), 2.55 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.4, 165.0, 137.3, 133.8, 133.6, 131.2, 129.9, 129.4, 129.0, 128.7, 127.8, 126.5, 113.3 (t, $^1J_{C,F}$ = 241.4 Hz), 73.5, 41.6 (t, $^2J_{C,F}$ = 26.6 Hz), 19.5 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dt, ^1J = 55.9 Hz, ^2J = 14.8 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{16}F_2NO_3$ $[M - H]^+$ 332.1098; found 332.1099.

1-(3-Bromophenyl)-2-(2,2-difluoroethylamino)-2-oxoethyl Benzoate (4l): White solid (177 mg, 89%); m.p. 92.7–93.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.11 (d, J = 7.6 Hz, 2 H), 7.70–7.28 (m, 7 H), 6.68 (t, J = 6.0 Hz, 1 H), 6.32 (s, 1 H), 5.87 (tt, ^1J = 55.8 Hz, ^2J = 3.4 Hz, 1 H), 3.76–3.60 (m, 2 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 168.7, 164.8, 137.1, 134.0, 132.4, 130.5, 130.3, 129.9, 128.8, 127.4, 126.1, 122.9, 113.2 (t, $^1J_{C,F}$ = 241.6 Hz), 74.9, 41.6 (t, $^2J_{C,F}$ = 26.4 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dt, ^1J = 55.8 Hz, ^2J = 14.7 Hz) ppm. HRMS (ESI): calcd. for $C_{17}H_{13}BrF_2NO_3$ $[M - H]^+$ 396.0047; found 396.0048.

2-(2,2-Difluoroethylamino)-2-oxo-1-*p*-tolylethyl Acetate (4m): White solid (122 mg, 90%); m.p. 97.1–98.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.34–7.20 (m, 4 H), 6.46 (t, J = 5.8 Hz, 1 H), 6.09 (s, 1 H), 5.85 (tt, ^1J = 55.9 Hz, ^2J = 4.1 Hz, 1 H), 3.73–3.62 (m, 2 H), 2.37 (s, 3 H), 2.20 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.3, 169.2, 139.3, 132.1, 129.6, 127.4, 113.3 (t, $^1J_{C,F}$ = 241.4 Hz), 75.3, 41.6 (t, $^2J_{C,F}$ = 26.6 Hz), 21.2, 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –123.0 (dt, ^1J = 55.9 Hz, ^2J = 14.7 Hz) ppm. HRMS (ESI): calcd. for $C_{13}H_{14}F_2NO_3$ $[M - H]^+$ 270.0942; found 270.0940.

2-(2,2-Difluoroethylamino)-1-(4-fluorophenyl)-2-oxoethyl Acetate (4n): White solid (126 mg, 92%); m.p. 116.8–118.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.44–7.05 (m, 4 H), 6.63 (t, J = 5.8 Hz, 1 H), 6.09 (s, 1 H), 5.85 (tt, ^1J = 55.8 Hz, ^2J = 3.9 Hz, 1 H), 3.73–3.61 (m, 2 H), 2.20 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 169.1, 169.0, 163.1 (d, $^{1'}J_{C,F}$ = 248.5 Hz), 131.0 (d, $^{4'}J_{C,F}$ = 3.4 Hz), 129.4 (d, $^{3'}J_{C,F}$ = 8.5 Hz), 115.9 (d, $^{2'}J_{C,F}$ = 21.9 Hz), 113.3 (t, $^1J_{C,F}$ = 241.4 Hz), 74.6, 41.5 (t, $^2J_{C,F}$ = 26.2 Hz), 20.9 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –111.9 to –112.0 (m), –123.1 (dt, ^1J = 55.8 Hz, ^2J = 14.9 Hz) ppm. HRMS (ESI): calcd. for $C_{12}H_{11}F_3NO_3$ $[M - H]^+$ 274.0691; found 274.0695.

General Procedure for the Synthesis of Compounds 5a–c: To a solution of **2a**–**d** (0.5 mmol) in dry toluene (1 mL) was added Bu_3SnH (870 mg, 1.5 mmol) under an argon atmosphere. Deoxygenation was continued for 5 min. AIBN (8 mg, 0.05 mmol) was added, and the solution was heated at reflux for 24 h (TLC). The mixture was concentrated under reduced pressure, and the residue was dissolved in EtOAc (5 mL). The solution was stirred overnight in the presence of KF/H_2O (15 mg/0.15 mL) and then extracted with EtOAc. The organic phase was washed successively with water and brine and then dried with anhydrous Na_2SO_4. After solvent removal, the crude products were purified by chromatography to give deacylation compounds **5a**–**c**.

***N*-[2,2-Difluoro-2-(phenylthio)ethyl]-2-hydroxy-2-phenylacetamide (5a):** White solid (108 mg, 67%); m.p. 74.1–75.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.57 (d, J = 7.2 Hz, 2 H), 7.45–7.34 (m, 8 H), 6.94 (t, J = 5.6 Hz, 1 H), 5.04 (s, 1 H), 3.91–3.71 (m, 2 H), 3.61 (s, 1 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 172.3, 138.9, 136.4, 130.2, 129.3, 128.9, 128.8, 127.4 (t, $^1J_{C,F}$ = 279.9 Hz), 127.0, 125.7, 74.4, 44.5 (t, $^2J_{C,F}$ = 29.0 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.0 (dt, $J_{F,F}$ = 213.0 Hz, $J_{H,F}$ = 12.4 Hz), –79.6 (dt, $J_{F,F}$ = 213.5 Hz, $J_{H,F}$ = 12.5 Hz) ppm. HRMS (ESI): calcd. for $C_{16}H_{15}F_2NO_2SNa$ $[M + Na]^+$ 346.0689; found 346.0689.

***N*-[2,2-Difluoro-2-(phenylthio)ethyl]-2-hydroxy-2-*p*-tolylacetamide (5b):** White solid (114 mg, 68%); m.p. 98.0–99.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.59 (d, J = 7.6 Hz, 2 H), 7.48–7.18 (m, 7 H), 6.99 (t, J = 5.7 Hz, 1 H), 5.00 (s, 1 H), 3.92–3.70 (m, 2 H), 3.88 (s, 1 H), 2.37 (s, 3 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 172.8, 138.6, 136.4, 136.1, 130.2, 129.5, 129.3, 128.2, 127.5 (t, $^1J_{C,F}$ = 279.9 Hz), 126.9, 74.2, 44.5 (t, $^2J_{C,F}$ = 28.9 Hz), 21.2 ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –78.8 (dt, $J_{F,F}$ = 212.7 Hz, $J_{H,F}$ = 12.4 Hz), –79.5 (dt, $J_{F,F}$ = 212.7 Hz, $J_{H,F}$ = 12.6 Hz) ppm. HRMS (ESI): calcd. for $C_{17}H_{17}F_2NO_2SNa$ $[M + Na]^+$ 360.0846; found 360.0844.

***N*-[2,2-Difluoro-2-(phenylthio)ethyl]-2-(3,4-dimethoxyphenyl)-2-hydroxyacetamide (5c):** White solid (138 mg, 57%); m.p. 120.5–121.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.57 (d, J = 7.6 Hz, 2 H), 7.47–6.85 (m, 6 H), 6.74 (t, J = 6.0 Hz, 1 H), 5.05 (s, 1 H), 3.99–3.73 (m, 2 H), 3.88 (s, 3 H), 3.86 (s, 3 H), 3.48 (s, 1 H) ppm. ^{13}C NMR (100 MHz, $CDCl_3$): δ = 172.5, 149.5, 149.4, 136.3, 131.4, 130.2, 129.3, 127.4 (t, $^1J_{C,F}$ = 279.9 Hz), 125.7, 119.8, 111.2, 109.7, 74.2, 56.0, 55.9, 44.5 (t, $^2J_{C,F}$ = 28.9 Hz) ppm. ^{19}F NMR (376 MHz, $CDCl_3$): δ = –79.1 (dt, $J_{F,F}$ = 213.0 Hz, $J_{H,F}$ = 12.3 Hz), –79.7 (dt, $J_{F,F}$ = 213.2 Hz, $J_{H,F}$ = 12.6 Hz) ppm. HRMS (ESI): calcd. for $C_{18}H_{19}F_2NO_4SNa$ $[M + Na]^+$ 406.0901; found 406.0899.

Supporting Information (see footnote on the first page of this article): Copies of the ^{1}H NMR, ^{13}C NMR, ^{19}F NMR spectra and high-resolution mass spectra.

Acknowledgments

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