SUPPORTING INFORMATION

SUPPLEMENTARY INFORMATION (14 Pages)

Elucidation of the Vicarious Nucleophilic Substitution of Hydrogen Mechanism *via* Studies of Competition between Substitution of Hydrogen, Deuterium and Fluorine.

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Experimental Section

General. Melting points are uncorrected. ^{1}H NMR and ^{13}C NMR spectra were recorded on Varian Gemini (200 MHz) and Brucker AM 500 (500 MHz) instruments. Chemical shifts are expressed in ppm referred to TMS, coupling constants in hertz. Mass spectra were obtained on an AMD-604 and HP 5972A MSD spectrometers. Elemental analyses were performed by Microanalysis Laboratory of IOC PAS. HPLC analyses were obtained on a SHIMADZU C-R4A/LC-8A chromatograph with UV-SPD-6A detector at 254 nm. HPLC columns 250×4 mm were packed with Nucleusil 100-C18/10 or 5 μm. GC analyses were performed on a HP 6890 chromatograph with HP-5 capillary column. Silica gel MERCK DC-Alufolien $60F_{254}$ or RP-$18F_{254}$ were used for TLC analyses. Silica gel Merck 60 7-230 mesh was used for column chromatography.

Starting materials and reagents:

Chloromethyl phenyl sulfone (2) was prepared from bromochloromethane and sodium benzenesulphinate;[24] mp 52 °C (lit.[24] mp 52 °C, lit.[25] mp 53 °C).

1-Chloroethyl phenyl sulfone (6) was prepared by methylation of **2**.[26] The crude product was treated with charcoal in MeOH then crystallized from MeOH and recrystallized from hexane. mp 55-6°C (lit[26] mp 52-54 °C, lit[27] mp 53 °C). Purity >95% (HPLC). Recognized impurities: 2-phenylsulfonyl-2-chloropropane (4%), and chloromethyl phenyl sulfone (0.5%).

***tert*-Butyl 4-nitrobenzoate** was prepared from 4-nitrobenzoic acid, analogously to the described esterification of 3,5-dinitrobenzoic acid;[28] mp 122.5-123 °C (MeOH) (lit.[29] mp116.5-118.5 °C (Et_2O)).

3-Fluoro-4-nitroanisole (1a) was prepared from 3-fluoro-4-nitrophenol by alkylation with dimethyl sulfate in the presence of anhydrous potassium carbonate in MeCN at ambient temperature. The product was recrystallized from hexane/ethyl acetate 8:1 mixture. Yield 80 %, mp 61 °C (lit.[30] mp 56 °C from petroleum ether).

4-Bromo-2-fluoronitrobenzene (1c) was obtained from 4-bromo-2-fluoroaniline by the Emmons oxidation[31] with 90 % H_2O_2. Isolation of the product was accomplished by steam distillation and recrystallization from anhydrous EtOH. Yield 56 %, mp 92 °C (lit.[32] mp 85-86 °C from EtOH).

***tert*-Butyl 3-fluoro-4-nitrobenzoate (1d)**:

To a stirred solution of *t*-BuOK (90 g, 0.8 mol) in DMF (300 mL) at. -30 °C was added during 3 min a solution of 2-nitrofluorobenzene (28.2 g, 0.2 mol) and methyl 2-chloropropionate (24.5g, 0.2 mol) in DMF (50 mL), then the second portion of the ester (12.3 g, 0.1 mol) was added during 1 min. After additional 5 min the reaction mixture was poured into ice/HCl_{aq} mixture and extracted with ethyl acetate. The extract was washed with water and dried over

$MgSO_4$. The solvent was evaporated, the residue was distilled under reduced pressure and a fraction at 116-117 °C (0.05 mmHg) was collected to obtain methyl 2-(3-fluoro-4-nitrophenyl) propionate, yield 34.0 g, (75 %), (lit.[33] 58 %). After standard oxidation with Na_2CrO_7/H_2SO_4 the crude 3-fluoro-4-nitrobenzoic acid was purified with charcoal in water, then recrystallized from water. Yield 16.1 g (58 %), mp 170-174 °C (lit.[34] mp 174-175 °C). Esterification of the acid was carried out analogously to that, described for 3,5-dinitrobenzoic acid.[28] Crude **1d** was recrystallized from MeOH. Yield 17.6 g (84 %), mp 82-83 °C (lit.[35] mp 68-70 °C ($MeOH/H_2O$)). Anal. Calcd for $C_{11}H_{12}NO_4F$ (241.22): C, 54.77; H, 5.01; N, 5.81. Found: C, 54.94; H ,4.88; N, 5.64.

4-Bromo-2-deuero-6-fluoronitrobenzene (1e) (99.9% atom D) and **4-bromo-2-deuteronitrobenzene (10)** (99.98% atom D) were prepared according to our original method.[36]

Remaining materials were commercial and they were purified before use by recrystallization or distillation if necessary. DMF was dried over CaH_2 and distilled at the pressure ca. 20 mmHg and stored under argon. THF was dried and distilled from sodium benzophenone ketyl. DMSO was dried and distilled over CaH_2.

3-Fluoro-5-methoxy-2-nitrobenzyl 4-methylphenyl sulfone (3a): To a vigorously stirred solution of *t*-BuOK (1.1 g, 10 mmol) in DMF (5 mL) at -50°C a solution of chloromethyl 4-tolyl sulfone (430 mg, 2.1 mmol) in DMF (1 mL) was added, then a solution of 2-fluoro-4-methoxynitrobenzene (306 mg, 2 mmol) in DMF (1 mL) was added. The mixture was stirred for 15 min then an excess of 10% HCl was added. The mixture was extracted with AcOEt, the organic layer was washed with water and brine and dried with $MgSO_4$. The solvent was evaporated and the products mixture was separated by column chromatography using hexane-AcOEt as an eluent and recrystallized from hexane-AcOEt to afford 111 mg of **3a** (17 %):

mp161-162 °C; ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.46 (s, 3H), 3.87 (s, 3H), 4.64 (s, 2H), 6.71-6.79 (m, 2H), 7.30-7.34 and 7.59-7.63 (m, AA'XX', 4H). MS (EI), m/z (%): 339 (M^+, 2), 293 (40), 184 (100), 155 (18), 138 (32), 91 (30). Anal. Calcd for $C_{14}H_{14}NO_5FS$ (327.33): C, 53.09; H, 4.16; N, 4.13. Found: C, 53.35; H, 4.11; N, 4.13.

Additionally 247 mg (36 %) of **4a** was isolated.

3,5-Difluoro -2-nitrobenzyl 4-methylphenyl sulfone (3b):

***tert*-Butyl (3,5-difluoro-2-nitrophenyl)[(4-methylphenyl)sulfonyl]acetate**: To NaH (660 mg, 22 mmol, 80 % in oil) was added $TsCH_2COO$*t*-Bu (5.68 g, 21 mmol) and DMSO (6 mL) at room temperature. The reaction mixture was heated to 70 °C for 10min then it was cooled down to room temperature. 2,4,6-Trifluoronitrobenzene (1.77 g 10 mmol) in DMSO (4 mL) was added dropwise during 2 min and the mixture was stirred for 20min at 50 °C and quenched with 10 % HClaq. The whole was extracted with CH_2Cl_2, the extract was washed with water, brine and dried with $MgSO_4$. After evaporation a light yellow oil was obtained (3.54 g, 83 %) being a 6:1mixture of 2- and 4- fluorine substitution product. The desired product was isolated by crystallization from AcOEt/hexane 1 : 4 mixture as a white solid, 2.95g (69 %), mp134 °C. ^{1}H NMR ($CDCl_3$, 200 MHz): δ 1.40 (s, 9H), 2.47 (s, 3H), 5.43 (d, J = 1.2, 1H), 7.07 (ddd, J = 9.7, 7.6, 2.7, 1H), 7.31-7.38 and 7.63-7.69 (m, AA'XX', 4H), 7.78 (ddd, J = 9.3, 2.7, 1.9, 1H); Anal. Calcd for $C_{19}H_{19}NF_2O_6S$ (427.42): C, 53.39; H, 4.48; N, 3.28. Found : C, 53.26; H, 4.44; N, 3.16.

3b: The ester (854 mg, 2 mmol) and TFA (3 mL) were stirred for 2 h at room temperature, then CH_2Cl_2 was added and the solvents were evaporated. The residue was crystallized from hot acetone to yield 622 mg (95 %) of **3b**, mp189-191 °C (acetone). ^{1}H NMR (DMSO-d_6, 500 MHz): δ 2.42 (s, 3H), 4.96 (s, 2H), 7.14 (ddd, J = 9.0, 2.5, 1.8, 1H), 7.44-7.45 and 7.60-7.62 (m, AA'XX', 4H), 7.79 (ddd, J = 10.9, 8.6, 2.7, 1H). ^{13}C NMR (DMSO-d_6, 125 MHz): δ 21.0

(s), 56.2 (s), 107.1 (dd, J_{CF} = 27.3, 25.0), 116.6 (dd, J_{CF} =24.7, 3.2), 126.4 (d, J_{CF} =11.2), 128.0 (s), 129.9 (s), 134.5 (s), 136.0 (dd, J_{CF} =12.2, 4.4), 145.2 (s), 155.0 (dd, J_{CF} = 259.6, 14.2), 162.1 (dd, J_{CF} = 254.4, 13.1). MS (EI), m/z (%): 327 (M^+, 0.2), 172 (50), 155 (93), 91 (100). HRMS (LSIMS, NBA): Found $(M + H)^+$ 328.04412. Calcd for $C_{14}H_{12}O_4NF_2S$ 328.04551. Anal. Calcd for $C_{14}H_{11}NF_2O_4S$ (327.3): C, 51.38; H, 3.39; N, 4.28. Found: C, 51.12; H, 3.33; N, 4.18.

5-Bromo-3-fluoro-2-nitrobenzyl 4-methylphenyl sulfone (3c) and **(5-bromo-2-nitrophenyl)(chloro)methyl 4-methylphenyl sulfone (4c)**: To a vigorously stirred solution of *t*-BuOK (1.1 g, 10 mmol) in DMF (5 mL) at -50°C a solution of chloromethyl 4-tolyl sulfone (430 mg, 2.1 mmol) in DMF (1 mL) was added, then a solution of 4-bromo-2-fluoronitrobenzene (440 mg, 2 mmol) in DMF (1 mL) was added. The mixture was stirred for 15 min then an excess of 10% HCl was added. The mixture was extracted with AcOEt, the organic layer was washed with water and brine and dried with $MgSO_4$. The products were separated and purified by column chromatography using Hexane-AcOEt as an eluent and recrystallized from AcOEt to afford 280 mg of **3c** (36%) and 259 mg of **4c** (32%).

3c: mp 180-181 °C. ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.47 (s, 3H), 4.55 (s, 2H), 7.32-7.36 and 7.59-7.63 (m, AA'XX', 4H), 7.41 (dd, J = 2.0, 1.6, 1H), 7.48 (dd, J = 9.0, 2.0, 1H). MS (EI), m/z (%): 389 (M^+, 0.5), 369 (0.6), 343 (6), 232 (31), 215 (7), 174 (3), 155 (96), 139 (7), 107 (7), 91 (100), 65 (16). HRMS (EI): Found (M^+) 386.95889. Calcd for $C_{14}H_{11}{}^{79}BrFNO_4S$ 386.95762. Anal. Calcd for $C_{14}H_{11}NO_4BrFS$ (388.21): C, 43.32; H, 2.86; N, 3.61. Found: C, 43.36; H, 2.78; N, 3.50.

4c: mp 175 °C. ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.48 (s, 3H), 7.11 (s, 1H), 7.35-7.40 (m, AA'XX', 2H), 7.71-7.77 (m, 3H), 7.95 (d, J = 8.7, 1H), 8.05 (d, J = 2.2, 1H). ^{13}C NMR ($CDCl_3$, 50MHz): δ 21.74, 68.49, 126.62, 126.80, 128.54, 129.85, 129.90, 131.43, 134.19,

134.54, 146.55, 147.50. MS (EI), m/z (%): 323 (M^+-NO2-Cl, 0.3), 250 (100), 222 (10), 192 (18), 169 (6), 155 (45), 141 (6), 123 (5), 91 (100), 65 (25). HRMS (LSIMS, NBA): Found (M + H)$^+$ 403.935639. Calcd for $C_{14}H_{12}{}^{79}BrClNO_4S$: 403.935894. Anal. Calcd for $C_{14}H_{11}NO_4BrClS$ (404.66): C, 41.55; H, 2.74; N 3.46. Found: C, 41.41; H, 2.63; N, 3.37.

***tert*-Butyl 3-fluoro-5-{[(4-methylphenyl)sulfonyl]methyl}-4-nitrobenzoate (3d)**: To a stirred solution of *tert*-butyl 3-fluoro-4-nitrobenzoate (241 mg, 1 mmol) and chloromethyl 4-tolyl sulfone (205 mg, 1 mmol) in DMF (4 mL) a solution of *t*-BuOK (280 mg, 2.5 mmol) in DMF (4 mL) was added during 1min and the mixture was stirred for 5min. An excess of 10% HCl was then added, the mixture was extracted with AcOEt, the extract was washed with water and brine and dried with $MgSO_4$. The solvent was removed and the crude product was purified by column chromatography using benzene-AcOEt mixture as an eluent and recrystallized from hexane/AcOEt to afford 115 mg (28%) of **3d**: mp 149-150 °C. ^{1}H NMR (CDCl3, 200MHz): δ 1.60 (s, 9H), 2.46 (s, 3H), 4.60 (s, 2H), 7.31-7.35 and 7.59-7.83 (m, AA'XX', 4H), 7.76-7.77 (m, 1H), 7.85 (dd, J = 9.8, 1.7, 1H). MS (EI), m/z(%): 409 (M^+, 0.4), 394 (0.7), 379 (0.3), 363 (2.4), 353 (13), 336 (35), 254 (36), 198 (100), 181 (38), 155 (42), 91 (22), 57 (12). Anal. Calcd for $C_{19}H_{20}NO_6FS$ (409.43): C, 55.73; H, 4.93; N, 3.42. Found: C, 55.71; H, 4.99; N, 3.48.

Chloro(5-methoxy-2-nitrophenyl)methyl 4-methylphenyl sulfone (4a): The same procedure as for **4d**, 4-methoxynitrobenzene was used instead of *tert*-butyl 4-nitrobenzoate. Yield 250 mg (70 %), mp 179-180 °C (AcOEt). ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.47 (s, 3H), 3.94 (s, 3H), 7.04 (dd, J = 9.2, 2.8, 1H), 7.30 (s, 1H), 7.34-7.38 and 7.75-7.79 (m, AA'XX', 4H), 7.48 (d, J = 2.9, 1H), 8.12 (d, J = 9.2, 1H). MS (EI), m/z (%): 355 (M^+, 1), 275 (6), 200

(100), 172 (26), 155 (8), 142 (35), 106 (17), 91 (18). Anal. Calcd for $C_{15}H_{14}ClNO_5S$ (355.79): C ,50.64; H, 3.97; N, 3.94. Found: C, 50.70; H, 3.87; N, 4.03.

Chloro(5-fluoro-2-nitrophenyl)methyl 4-methylphenyl sulfone (4b): To a vigorously stirred solution of 4-fluoronitrobenzene (423 mg, 3 mmol) and dichloromethyl 4-tolyl sulfone (717 mg, 3 mmol) in THF (3 mL) a solution of *t*-BuOK (1.12 g, 10 mmol) in THF (2 mL) was added at -78°C. After stirring for 20min 10% HCl_{aq} was added, the mixture was diluted with AcOEt, washed with water and brine, dried with $MgSO_4$ and separated by column chromatography using hexane-AcOEt to afford a mixture of two products: **4b** and chloro(4-nitrophenyl)methyl 4-methylphenyl sulfone. 4-Fluoronitrobenzene (41 %) was also recovered. Recrystallization of the product mixture from hexane/AcOEt yielded 292 mg (30 %) of **4b**, mp 139-141 °C; ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.48 (s, 3H), 7.16 (d, J = 1.1, 1H), 7.30 (ddd, J = 9.1, 6.8, 2.8, 1H), 7.34-7.42 (m, AA'XX', 2H), 7.72 (dd, J = 9.1, 2.8, 1H), 7.74-7.80 (m, AA'XX', 2H), 8.15 (dd, J = 9.1, 5.0, 1H). ^{13}C NMR ($CDCl_3$, 50MHz): δ 21.8 (s), 68.7 (s), 118.1 (d, J_{CF} = 22.9), 119.1 (d, J_{CF} = 26.3), 128.2 (d, J_{CF} = 9.9), 128.6 (d, J_{CF} =9.1), 129.9 (s), 130.0 (s), 131.8 (s), 145.0 (d, J_{CF} =3.2), 146.6 (s), 164.6 (d, J_{CF} = 257.3). MS (EI), m/z (%): 263 (M^+-Cl -NO_2, 2), 188 (M^+-Ts, 68), 155 (42), 130 (26), 107 (23), 91(100). HRMS (LSIMS, NBA): Found $(M+Na)^+$ 365.99864. Calcd for $C_{14}H_{11}O_4NSF^{35}ClNa$ 365.99791. Anal. Calcd for $C_{14}H_{11}NClFO_4S$ (343.76): C, 48.92; H, 3.23; N, 4.07. Found: C, 49.01; H, 3.12; N, 4.14.

Chloro(4-nitrophenyl)methyl 4-methylphenyl sulfone was isolated by recrystallization from hexane/AcOEt, yield 8 %, mp 201-203 °C; ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.48 (s, 3H), 5.73 (s, 1H), 7.31-7.38 (m, AA'XX', 2H), 7.58-7.69 (m, AA'XX', 4H), 8.18-8.26(m, AA'XX', 2H). ^{13}C NMR ($CDCl_3$, 50MHz): δ 21.8, 74.7, 123.5, 129.8, 130.3, 130.7, 131.1, 137.2, 146.5, 148.9; MS (EI), m/z (%): 325 (M^+, 7), 291 (4), 170 (100), 155 (59), 91 (71);

HRMS (EI): Found (M^+) 325.01713. Calcd for $C_{14}H_{12}O_4NS^{35}Cl$: 325.01756. Anal. Calcd for $C_{14}H_{12}NClO_4S$ (325.78): C, 51.62; H, 3.71; N, 4.30. Found: C, 51.55; H, 3.70; N, 4.26.

Chloro(3-fluoro-4-nitrophenyl)methyl 4-methylphenyl sulfone (4b'): To a vigorously stirred solution of *t*-BuOK (224 mg, 2 mmol) in DMSO (1 mL) a solution of dichloromethyl 4-tolyl sulfone (480 mg, 2 mmol) in DMSO (1 mL) was added at room temperature and then a solution of 2-fluoronitrobenzene (282 mg, 2 mmol) in DMSO (1 mL) was added. A solution of *t*-BuOK (337mg, 3mmol) in DMSO (1 mL) was then added dropwise during 2 min at room temperature. After stirring for 5min 10% HCl_{aq} was added, the mixture was diluted with AcOEt, washed with water and brine, dried with $MgSO_4$ and the solvent was evaporated. The two products and recovered starting nitroarene were separated by column chromatography (SiO_2, hexane-CH_2Cl_2):

4b': yield 69mg (10%); mp 142-143 °C (hexane-CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.49 (s, 3H), 5.68 (s, 1H), 7.34-7.46 (m, 4H), 7.66-7.72 (m, AA'XX', 2H), 8.06 (dd, J = 8.8, 7.5, 1H). ^{13}C NMR (CDCl3, 50MHz): δ 21.8 (s), 73.9 (s), 119.9 (d, J_{CF} = 23.0), 125.8 (d, J_{CF} = 4.4), 126.0 (d, J_{CF} = 2.3), 129.9 (s), 130.0 (d, J_{CF} = 2.5), 130.3 (s), 130.9 (s), 138.5 (d, J_{CF} = 7.8), 146.8 (s), 154.8 (d, J_{CF} = 265.2). MS (EI), m/z(%): 343 (M^+, 6), 188 (26), 155 (100), 91 (77). HRMS (EI): Found 345.00498. Calcd for $C_{14}H_{11}O_4NS^{37}ClF$ 345.00519. Anal. Calcd for $C_{14}H_{11}NClFO_4S$ (343.76): C, 48.92; H, 3.23; N, 4.07. Found: C, 48.58; H, 3.07; N, 4.02.

Chloro(2-nitrophenyl)methyl 4-methylphenyl sulfone, yield 70mg (11%); mp125-126 °C (Hexane-AcOEt); ^{1}H NMR ($CDCl_3$, 200MHz): δ 2.48 (s, 3H), 7.10 (s, 1H), 7.33-7.38 (m, AA'XX', 2H), 7.62 (ddd, J = 7.5, J = 7.9, J = 1.6, 1H), 7.70-7.78 (m, 3H), 8.10-8.80 (m, 2H). ^{13}C NMR ($CDCl_3$, 50MHz) δ 21.76, 69.06, 125.10, 125.22, 129.89, 131.11, 131.77, 132.03, 132.43, 133.56, 146.28, 148.90. MS (EI), m/z(%): 170(M^+-Ts, 100), 155 (18), 112 (59), 91 (85). HRMS (LSIMS, NBA): Found $(M+H)^+$ 326.02776. Calcd for $C_{14}H_{13}O_4NS^{35}Cl$

326.02538. Anal. Calcd for $C_{14}H_{12}NClO_4S$ (325.78): C, 51.62; H, 3.71; N, 4.30. Found: C, 51.45; H, 3.97; N, 4.21.

2-Fluoronitrobenzene recovered 140 mg (50%).

***tert*-Butyl 3-{chloro[(4-methylphenyl)sulfonyl]methyl}-4-nitrobenzoate (4d)**: To a vigorously stirred solution of *t*-BuOK (1.12 g, 10 mmol) in THF (8 mL) a solution of *tert*-butyl 4-nitrobenzoate (223 mg, 1 mmol) and dichloromethyl 4-tolyl sulfone (287 mg, 1.2 mmol) in THF (2 mL) was added dropwise during 1min at -70 °C and stirred for 40min. 10% HCl_{aq} was then added, the mixture was diluted with AcOEt, washed with water and brine, dried with $MgSO_4$ and purified by column chromatography using hexane-AcOEt. Recrystallization of the crude product from hexane/AcOEt yielded 213 mg (50 %) of **4d**, mp 161-162 °C. ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.62 (s, 9H), 2.48 (s, 3H), 7.06 (s, 1H), 7.34-7.39 and 7.71-7.76 (m, AA'XX', 4H), 8.07 (d, J = 8.5, 1H), 8.19 (dd, J = 8.5, 1.8, 1H), 8.49 (d, J = 1.8, 1H). MS (EI), m/z (%): 369 (M^+-Bu, 1), 352 (18), 270 (69), 214 (100), 197 (5), 186 (13), 179 (14), 155 (18), 139 (11), 91 (38). HRMS (LSIMS, NBA): Found $(M + Na)^+$ 448.05610. Calcd for $C_{19}H_{20}O_6NS^{35}ClNa$ 448.05976. Anal. Calcd for $C_{19}H_{20}O_6NSCl$ (425.88): C, 53.58; H, 4.73; N, 3.29. Found: C, 53.47; H, 4.83; N, 3.06.

5-Methoxy-2-nitrobenzyl 4-methylphenyl sulfone (5a): To a vigorously stirred solution of *t*-BuOK (112 mg, 1 mmol) in DMF/THF 2:1 (0.5 mL) at -30°C a solution of 4-nitroanisole (15 mg, 0.1 mmol) and chloromethyl *p*-tolyl sulfone (20 mg, 0.1 mmol) in DMF/THF 2:1 mixture (0.5 mL) was added dropwise during 30 s. After stirring for 30 min 10% HCl_{aq} was added, the mixture was extracted with AcOEt, the extract was washed with water and dried with $MgSO_4$. The solvent was removed and the crude product was purified by column chromatography (hexane/AcOEt). Yield 27 mg (84 %). mp 143 °C (hexane/AcOEt) (lit[38]

mp 140-145 °C (MeOH)). Anal. Calcd for $C_{15}H_{15}NO_5S$ (312.35): C, 56.07; H, 4.70; N, 4.36; S, 9.98. Found: C, 56.27 H, 4.68; N, 4.35; S, 9.95.

5-Fluoro-2-nitrobenzyl 4-methylphenyl sulfone (5b): Obtained in the VNS reaction of 4-fluoronitrobenzene and chloromethyl *p*-tolyl sulfone in *t*-BuOK/THF system, analogously to the described earlier procedure for 5-fluoro-2-nitrobenzyl phenyl sulfone[7]. mp175-176 °C (hexane-AcOEt). ^{1}H NMR ($CDCl_3$, 200 MHz): δ 2.45 (s, 3H), 4.91 (s, 2H), 7.16-7.36 (m, 4H), 7.56-7.62 (m, 2H), 8.04 (dd, J = 9.6, 5.0, 1H). MS (EI), m/z (%): 309 (M^+, 0.2), 263 (18), 154 (100), 137 (14), 108 (30), 91 (88). Anal. Calcd for $C_{14}H_{12}NFO_4S$ (309.31): C, 54.36; H, 3.91; N, 4.53. Found: C, 54.12; H, 3.97; N, 4.57.

3-Fluoro-4-nitrobenzyl 4-methylphenyl sulfone (5b'): To a vigorously stirred solution of *t*-BuOK (898 mg, 8 mmol) in DMSO (8 mL) a solution of 2-fluoronitrobenzene (423 mg, 3 mmol) and bromomethyl 4-tolyl sulfone (747 mg, 3 mmol) in DMSO (2 mL) was added dropwise during 15s at room temperature. After stirring for 3 min 10% HCl was added, the mixture was diluted with AcOEt, washed with water and brine, dried with $MgSO_4$ and purified by a column chromatography with Hexane-AcOEt. The crude product was recrystallized from hexane/AcOEt. Yield 535mg (43 %), mp 181-183 °C; ^{1}H NMR ($CDCl_3$, 200MHz) δ 2.46 (s, 3H), 4.34 (s, 2H), 7.03-7.15 (m, 2H), 7.29-7.35 and 7.55-7.61 (m, AA'XX', 4H), 7.94-8.02 (m, 1H). MS (EI), m/z (%): 309 (M^+, 13), 155 (92), 91 (100). HRMS (EI): Found 309.04755. Calcd for $C_{14}H_{12}O_4NFS$ 309.04711. Anal. Calcd for $C_{14}H_{12}NFO_4S$ (309.31): C, 54.36; H, 3.91; N, 4.53. Found: C, 54.18; H, 3.97; N, 4.46.

5-Bromo-2-nitrobenzyl 4-methylphenyl sulfone (5c): To a vigorously stirred solution of 4-bromonitrobenzene (404 mg, 2 mmol) and chloromethyl *p*-tolyl sulfone (410 mg, 2 mmol) in

DMSO (5 mL), powdered KOH (560 mg, 10 mmol) was added in one portion. After stirring for 1h an excess of 10% HCl was added and the mixture was extracted with AcOEt, the extract was washed with water and brine, dried with $MgSO_4$ and the solvent was evaporated. The product was isolated by column chromatography with hexane-AcOEt. The crude product was recrystallized from AcOEt to afford 363 mg (49%) of **5c**: mp 177-177.5 °C. ^{1}H NMR ($CDCl_3$, 200 MHz) δ 2.45 (s, 3H), 4.87 (s, 2H), 7.28-7.33 (m, AA'XX', 2H), 7.55-7.60 (m, 3H), 7.66 (dd, J = 8.7, 2.1, 1H), 7.86 (d, J = 8.7, 1H). ^{13}C NMR ($CDCl_3$/acetone-d_6, 50MHz) δ 21.5, 58.1, 126.1, 127.5, 127.6, 128.93, 130.4, 133.6, 135.9, 137.6, 145.9, 149.3. MS (EI), m/z (%): 371(M^+, 0.2), 341(0.7), 325(16), 214(57), 197(8), 184(8), 155(56), 139(11), 91(100), 77(19), 65(21). HRMS (LSIMS, NBA): Found $(M+H)^+$ 369.975004. Calcd for $C_{14}H_{13}{}^{79}BrNO4S$: 369.974866. Anal. Calcd for $C_{14}H_{12}BrNO_4S$ (370.22): C, 45.42; H, 3.27; N, 3.78. Found: C, 45.42; H, 3.21; N, 3.59.

***tert*-Butyl 3-{[(4-methylphenyl)sulfonyl]methyl}-4-nitrobenzoate (5d)**: To a vigorously stirred solution of *t*-BuOK (561 mg, 5 mmol) in DMF (3 mL) at -30°C was added a solution of chloromethyl *p*-tolyl sulfone (307 mg, 1.5 mmol) in DMF (2 mL), then a solution of *tert*-butyl 4-nitrobenzoate (223 mg, 1 mmol) in DMF (1 mL) was added dropwise. After stirring for 10 min an excess of 10% HCl was added. The mixture was extracted with AcOEt, the extract was washed with water and brine, dried with $MgSO_4$ and the solvent was evaporated. The crude product was purified by column chromatography with hexane-AcOEt as an eluent, then recrystallized from hexane-AcOEt. Yield 274 mg (70 %); mp 146-148 °C; MS (EI), m/z (%): 345(4), 335(7), 318(17), 291(2), 236(35), 180(100), 163(17), 155(9), 135(9). ^{1}H NMR ($CDCl_3$, 200 MHz): 1.60(s, 9H), 2.45(s, 3H), 4.92(s, 2H), 7.27-7.31 i 7.55-7.60(m, AA'XX', 4H), 7.94(d, J = 1.6, 1H), 8.00(d, J = 8.4, 1H), 8.10(dd, J = 8.5, 1.8, 1H). Anal. Calcd for $C_{19}H_{21}NO_6S$ (391.44): C, 58.30; H, 5.41; N, 3.58. Found: C, 58.24; H, 5.37; N, 3.48.

***tert*-Butyl 3-fluoro-4-nitro-5-[1-(phenylsulfonyl)ethyl]benzoate (7)**: To a solution of **1d** (720 mg, 3 mmol) and 1-chloroethyl phenyl sulfone (**6**) (714 mg, 3.5mmol) in DMF (10 mL) stirred at -50 °C a solution of *t*-BuOK (785 mg, 7 mmol) in DMF (4mL) was added during 5 min. The mixture was then acidified with 10% HCl, diluted with AcOEt, washed with water and brine. The organic layer was dried with $MgSO_4$ and the solvents evaporated. Separation by column chromatography (SiO_2, Hexane-AcOEt) gave 368 mg (30%) of **7** and 407 mg (46%) of *tert*-butyl 3-*tert*-butoxy-4-nitrobenzoate.

7: mp 97-98 °C (MeOH); ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.62 (s, 9H), 1.79 (d, J = 7.0, 3H), 4.61 (q, J = 7.1, 1H), 7.47-7.71 (m, 5H), 7.82 (dd, J = 9.6, J = 1.6, 1H), 8.12 (dd, J = 1.5, J = 1.4, 1H). MS (EI), m/z (%): 336 (8), 290(5), 268 (44), 226 (6), 212 (100), 167 (6), 149 (17), 109 (7); Anal. Calcd for $C_{19}H_{20}NO_6SF$ (409.43): C, 55.73; H, 4.93; N, 3.42. Found: C, 55.58; H, 4.88; N, 3.30.

***tert*-Butyl 3-*tert*-butoxy-4-nitrobenzoate**: mp 66-67 °C (MeOH); ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.46 (s, 9H), 1.61 (s, 9H), 7.65-7.74 (m, 2H), 7.84-7.85 (m, 1H). ^{13}C NMR ($CDCl_3$, 50MHz): δ 28.03, 28.78, 82.35, 83.13, 123.24, 124.28, 124.69, 135.64, 148.85, 163.74, 201.09. MS (EI), m/z(%): 295 (M^+, 0.4), 280 (8), 239 (17), 222 (7), 183 (22), 166 (26), 57 (100), 41 (12). HRMS, found 295.13926. Calcd for $C_{15}H_{21}NO_5$ 295.14197. Anal. Calcd for $C_{15}H_{21}NO_5$ (295.34): C, 61.00; H, 7.17; N, 4.74. Found: C, 60.91; H, 7.21; N, 4.69.

***tert*-Butyl 3-[1-chloro-1-(phenylsulfonyl)ethyl]-4-nitrobenzoate (8)**:

***tert*-Butyl 3-[chloro(phenylsulfonyl)methyl]-4-nitrobenzoate**: The same procedure as for **4d**, yield 52%. mp 149-150 °C (MeOH); ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.62 (s, 9H), 7.10 (s, 1H), 7.54-7.91 (m, 5H), 8.09 (d, J = 8.4, 1H), 8.20 (dd, J = 8.5, 1.8, 1H), 8.50 (d, J = 1.8, 1H). Anal. Calcd for $C_{18}H_{18}NClO_6S$ (411.86): C, 52.49; H, 4.41; N, 3.40. Found: C, 52.30; H, 4.28; N, 3.34.

8: To a solution of tert-Butyl 3-[chloro(phenylsulfonyl)methyl]-4-nitrobenzoate (412 mg, 1 mmol) in DMSO (7 mL) freshly calcinated K_2CO_3 (1,52 g, 11 mmol) and MeI (188 µl, 3 mmol) were added. After stirring for 8h under argon at room temperature the mixture was poured onto solid NH_4Cl, extracted with AcOEt and after standard isolation procedure purified by column chromatography (SiO_2, Hexane-AcOEt). Yield 71%, mp 128-129 °C (hexane-AcOEt); ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.61 (s, 9H), 2.33 (s, 3H), 7.30 (d, J = 8.3, 1H), 7.46-7.75 (m, 5H), 8.10 (dd, J = 8.2, 1.7, 1H), 8.58 (d, J = 1.7, 1H). MS (EI), m/z (%): 352 (12), 284 (60), 228 (55), 193 (9), 176 (10), 77 (14), 57 (22). HRMS (LSIMS), found 448.05757. Calcd for $C_{19}H_{20}NO_6SClNa$ 448.05976. Anal. Calcd for $C_{19}H_{20}NClO_6S$ (425.88): C, 53.58; H, 4.73; N, 3.29. Found: C, 53.26; H, 4.99; N, 3.21.

***tert*-Butyl 3-[1-(phenylsulfonyl)ethyl]-4-nitrobenzoate (9)**: To a vigorously stirred solution of *t*-BuOK (561 mg, 5 mmol) in DMF (3 mL) a solution of 4-nitrobenzoic acid tert-butyl ester (223 mg, 1 mmol) and chloromethyl phenyl sulfone (306 mg, 1.6 mmol) in DMF (3 mL) were added at -30°C. After stirring for 10 min an excess of MeI was added and the reaction was warmed up to room temperature during 20min. After that 10% HCl was added, the mixture was diluted with AcOEt, washed with water and brine, dried with $MgSO_4$ and the crude product was purified by column chromatography (SiO_2, Hexane-AcOEt).Yield 64%. mp 142-143 °C (hexane-AcOEt); ^{1}H NMR ($CDCl_3$, 200MHz): δ 1.62 (s, 9H), 1.81 (d, J = 7.1, 3H), 5.42 (q, J = 7.0, 1H), 7.44-7.69 (m, 5H), 7.83 (d, J = 8.4, 1H), 8.06 (dd, J = 8.4, 1.8, 1H), 8.30 (d, J = 1.8, 1H). MS (EI), m/z (%): 374 (M^+-OH, 16), 86 (100). Anal. Calcd for $C_{19}H_{21}NO_6S$ (391.44): C, 58.30; H, 5.41; N, 3.58. Found: C, 58.56; H, 5.67; N, 3.39.

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37. Product **8**, originated from the fluorine displacement in **1d** with **C-6** (Scheme 4) was not observed in the reaction mixtures due to the fast dechlorination process leading to **9** therefore, the P^H/P^F ratios were calculated on the basis of the [7]/[9] ratio values. In order to avoid a question of efficiency of the dechlorination process, the calibrations of HPLC analyses were made using samples of **9** prepared directly from **8** and *t*-BuOK under reaction conditions of Scheme 4.

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