A robust pure hydrocarbon derivative based on the (2,1-*b*)-indenofluorenyl core. with high triplet energy level

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MATERIAL AND METHODS

Synthesis: Commercially available reagents and solvents were purchased from Alfa Aesar, Acros Organics or Sigma-Aldrich and used without further purification other than those detailed below. Dichloromethane and acetonitrile were distilled from P_2O_5 drying agent Sicapent[©] (Merck); THF was distilled from sodium/benzophenone prior to use. Light petroleum refers to the fraction with bp 40-70°C. Reactions were stirred magnetically, unless otherwise indicated. Analytical thin layer chromatography was carried out using aluminium backed plates coated with Merck Kieselgel 60 GF254 and visualized under UV light (at 254 and 365 nm). Chromatography was carried out using silica 60A CC 40-63 µm (SDS). ¹H, ¹³C and NMR spectra were recorded using Bruker 300 MHz 1 H frequency, corresponding 13 C frequency is 75 MHz and corresponding); chemical shifts were recorded in ppm and J values in Hz. In the ¹³C NMR spectra, signals corresponding to CH, CH₂ or Me groups, assigned from DEPT, are noted; all others are C. The residual signals for the NMR solvents are : CDCl₃; 7.26 ppm for the proton and 77 ppm for the carbon, CD₂Cl₂; 5.32 ppm for the proton and 53.80 ppm for the carbon, DMSO-d6; 2.50 ppm for the proton and 39.52 ppm for the carbon, THF-d8; 3.58 ppm for the proton and 67.57 ppm for the carbon. The following abbreviations have been used for the NMR assignment: s for singlet, d for doublet, t for triplet, m for multiplet and br for broad. High resolution mass spectra were recorded at the Centre Régional de Mesures Physiques de l'Ouest (Rennes) on (i) Bruker MicrO-Tof-Q II (Source: Atmospheric Pressure Chemical Ionisation (APCI - direct introduction (ASAP-Atmospheric Solids Analysis Probe) at a temperature of 30°C - positive mode) or on (ii) Waters Q-Tof II (source: electrospray (ESI)). (1,2-b)-DSF(t-Bu)₄-IF 2 has been synthesized according to literature procedures.¹

<u>X Ray:</u> Crystal data of **1** are presented below. Crystal was picked up with a cryoloop and then frozen at 150 K under a stream of dry N₂ on a APEX II Brucker AXS diffractometer for X-ray data collection (Mo K α radiation, $\lambda = 0.71073$ Å). Structure was solved by direct methods (SIR97),² and then refined by full-matrix least-square methods based on F^2 (*SHELXL-97*)³ as implemented in the WinGX software package.⁴ An empirical absorption correction was applied. Hydrogen atoms were introduced at calculated positions (riding model) included in structure factor calculation but not refined.

Electrochemical studies: All electrochemical experiments were performed under an argon atmosphere, using a Pt disk electrode (diameter 1 mm), the counter electrode was a vitreous carbon rod and the reference electrode was a silver wire in a 0.1 M AgNO₃ solution in CH₃CN. Ferrocene was added to the electrolyte solution at the end of a series of experiments. The ferrocene/ferrocenium (Fc/Fc⁺) couple served as internal standard. The three electrode cell was connected to a PAR Model 273 potentiostat/galvanostat (PAR, EG&G, USA) monitored with the ECHEM Software. Dichloromethane with less than 100 ppm of water (ref. SDS 02910E21) was used without purification. Activated Al₂O₃ was added in the electrolytic solution to remove excess moisture. All potentials are referred to the SCE electrode that was calibrated at -0.405 V vs. Fc/Fc⁺ system. The oxidation/reduction onset potential ($E_{onset}^{ox}/E_{onset}^{red}$) were determined on the CVs by the intersection of the tangent of the first oxidation/reduction wave with the potential axis. The estimated errors in the determination of the onset potential values are ± 20 mV for E_{onset}^{ox} and ± 50 mV for E_{onset}^{red} . The electron affinity (LUMO energy level) and the ionization potential (HOMO energy level) of the molecules were determined from their E_{onset}^{red} and E_{onset}^{ox} using the following formula based on an SCE energy level of 4.4 eV relative to the vacuum: ⁵ HOMO (eV) = -[E_{onset}^{ox}

(vs SCE) + 4.4] and LUMO (eV)= $-[E_{onset}^{red}$ (vs SCE) + 4.4]. The electrochemical gap was calculated from : $\Delta E^{el} = |HOMO-LUMO|$ (in eV). The LUMO level has also been estimated from the HOMO energy level and the optical band gap ΔE^{opt} estimated from the edge of the absorption spectrum using the following formula: $\Delta E^{opt} + HOMO = LUMO$ (in eV) with $\Delta E^{opt} = hc/\lambda$, using : ΔE^{opt} (eV) = 1237.5 / λ (nm).

Spectroscopic studies: 1 and 2 were either studied in THF solution (room temperature measurements) or in 2-methylcyclohexane / methylpentane 1:1 solution (room temperature down to 77K) which freezes as a transparent glassy matrix at low temperature. Variable temperature measurements were performed using a single-block quartz cuvette containing the solution, which was placed in an Oxford Optistat cryostat cooled with liquid nitrogen, equipped itself with three quartz optical windows. UV-visible absorption spectra were recorded on a double beam Uvikon-940 (Kontron) or a Varian Cary 5000 (Agilent) spectrometers. Fluorescence and phosphorescence emission spectra were recorded on a Horiba Jobin-Yvon Fluorolog FL3-221 in the continuous excitation mode. The optical band gap was calculated from the edge of the emission spectrum using the formula ΔE^{opt} (eV) = hc/ λ = 1237.5/ λ , λ being the transition edge wavelength (in nm). Phosphorescence decays were monitored in the same instrument operating a flash Xenon lamp (FWHM~3µs) with a sample window of 1s delayed from the light pulse by 50µs up to ~100s with time increments of 1s to 2s.

Fluorescence intensity decays were obtained by the time-correlated single-photon counting (TCSPC) method with femtosecond laser excitation using a Spectra-Physics set-up composed of a Titanium Sapphire Tsunami laser pumped by a doubled YAG laser Millennia, pumped itself by two laser diode arrays. Light pulses at 990 nm were selected by optoacoustic crystals at a repetition rate of 4 MHz. The third harmonics at 330 nm was obtained through non-linear crystals. Fluorescence photons were detected through a monochromator by means of a Hamamatsu MCP R3809U photomultiplier. The time-to-amplitude converter was purchased from Tennelec. The fluorescence data were analyzed by a nonlinear least-squares global method using the Globals software package developed at the Laboratory for Fluorescence Dynamics at the University of Illinois at Urbana-Champaign.

<u>Thermal analysis:</u> Thermogravimetric analyses (TGA) were carried out with a Rigaku Thermoflex instrument under a nitrogen atmosphere between with a heating rate of 5° C.min⁻¹. Melting points were determined using an electrothermal melting point apparatus.

Computational Details: Full geometry optimization with Density functional theory (DFT)^{6,7} and Time-Dependent Density Functional Theory (TD-DFT) calculations were performed with the hybrid Becke-3 parameter exchange⁸⁻¹⁰ functional and the Lee-Yang-Parr non-local correlation functional¹¹ (B3LYP) implemented in the Gaussian 09 (Revision A.02) program suite¹² using the 6-31G* basis set¹³ and the default convergence criterion implemented in the program. The figures were generated with MOLEKEL 4.3.¹⁴

SYNTHESIS



Sodium bis(trimethylsilyl)amide (45 mL, 90 mmol) was added dropwise to a stirred solution of 2bromoaniline (7.68 g, 45 mmol) in dry THF (41 mL) at room temperature under an argon atmosphere. After 25 min, di-t-butyldicarbonate (10.4 g, 45 mmol) was added over 5 min via syringe. The reaction mixture was stirred at room temperature for 2 h. Water (100 mL) was then added, and the resulting mixture was extracted with dichloromethane (5×100 mL). The organic layer was washed with a saturated aqueous solution of sodium chloride (100 mL), dried (MgSO₄), and evaporated in *vacuo*. Purification by column chromatography on silica gel eluting with ethyl acetate/light petroleum (0.5:9.5 to 1:9) gives 9.3 g (76%) of compound **3** as a yellow oil; HRMS (ESI⁺, MeOH): m/z: calc for C₁₁H₁₄NO₂⁷⁹BrNa: 294.01056; [M+Na]⁺ found: 294.0106; ¹H NMR (300 MHz, CDCl₃, ppm) : δ 8.15 (1H, dd, *J*=7.9 Hz, *J*=1.3 Hz, ArH), 7.49 (1H, dd, *J*= 7.9 Hz, *J*=1.5 Hz, ArH), 7.27 (1H, td, *J*=7.9 Hz, *J*=1.3 Hz, ArH), 7.01 (1H, br s, NH), 6.88 (1H, td, *J*=7.9 Hz, *J*=1.5 Hz, ArH), 1.54 (9H, s, Me); ¹³C NMR (75 MHz, CDCl₃, ppm) : δ 152.2 (CO), 136.1 (C), 132.1 (CH), 128.1 (CH), 123.7 (CH), 119.9 (CH), 112.2 (<u>C</u>Br), 80.9 (<u>C</u>Me), 28.1 (Me); IR (ATR, cm⁻¹) : v = 3413 (NH), 2977, 2930, 1732 (C=O), 1590, 1514, 1431, 1391, 1366, 1300, 1244, 1220, 1149, 1060 (C-O), 1019 (C-O).



Sodium carbonate (3.30 g, 31.50 mmol) dissolved in water (7 mL) was added to a solution of tertbutyl (2-bromophenyl)carbamate 3 (2.16 g, 8 mmol), 1,3-phenylene bisboronic acid (0.5 g, 3.2 mmol) and 1,1'-bis(diphenylphosphino)ferrocene palladium(II)dichloride dichloromethane complex (0.13 g, 0.1 mmol) in DMF (22 mL) at room temperature. The schlenk tube was degassed, and the mixture was allowed to stir at 90°C for 12 h under an argon atmosphere. The reaction mixture was then guenched with water (100 mL) and extracted with dichloromethane (4×50 mL). The combined organic layers were washed with a saturated aqueous solution of sodium hydrogencarbonate (50 mL), dried (MgSO₄) and evaporated in *vacuo*. Purification by column chromatography on silica gel eluting with ethyl acetate/light petroleum (1:10) affords 1 g (87%) of compound **4** as an orange oil; HRMS (ESI⁺, MeOH): m/z: calc for $C_{28}H_{32}N_2O_4Na$: 483.22598; [M+Na]⁺ found: 483.2260. ¹H NMR (300 MHz, CDCl₃, ppm) : δ 8.06 (2H, d, J=8.5 Hz, ArH), 7.59 (1H, t, J=7.1 Hz, ArH), 7.45-7.24 (7H, m, ArH), 7.13 (2H, td, J=7.5 Hz, J=1 Hz, ArH), 6.54 (2H, s, NH), 1.47 (18H, s, Me); ¹⁵C NMR (75 MHz, CDCl₃, ppm) : δ 152.9 (CO), 139.3 (C), 135.1 (C), 131.2 (C), 130.5 (CH), 130.2 (CH), 129.5 (CH), 128.6 (CH), 128.4 (CH), 123.4 (CH), 120.7 (CH), 80.6 (CMe), 28.3 (Me); IR (ATR, cm^{-1}) : v = 3427 (NH), 3352 (NH), 3060, 2977, 2930, 1717 (C=O), 1584, 1511, 1484, 1441, 1366, 1298, 1231, 1149, 1045 (C-O), 1022 (C-O).



Trifluoroacetic acid (5.95 mL, 80.0 mmol) was added to a solution of 4 (1.4 g, 3 mmol) dissolved in dichloromethane (70 mL) at room temperature. The reaction mixture was allowed to stir at room temperature for 3 h. The mixture was cooled to 0°C and carefully neutralized (pH~7-8) with a saturated aqueous solution of sodium hydrogencarbonate and the resulting mixture was extracted with dichloromethane $(3 \times 50 \text{ mL})$. The organic layer was dried (MgSO₄) evaporated in *vacuo* to give 0.77 g (99%) of compound 5 as а beige solid: mp (light petroleum) 118°C; HRMS (APCI-ASAP): m/z: calc for $C_{18}H_{17}N_2$: 261.1392; $[M+H]^+$ found:, 261.1393; ¹H NMR (300 MHz, CDCl₃, ppm) : δ 7.61-7.40 (4H, m, ArH), 7.21-7.13 (4H, m, ArH), 6.87-6.75 (4H, m, ArH), 3.82 (4H, br, NH₂); ¹³C NMR (75 MHz, CDCl₃, ppm) : δ 143.8 (C), 140.5 (C), 130.8 (CH), 130.0 (CH), 129.6 (CH), 129.0 (CH), 128.1 (CH), 127.6 (C), 119.1 (CH), 116.1 (CH); IR (ATR, cm⁻¹) : v = 3471 (NH₂), 3441 (NH₂), 3374 (NH₂), 3370 (NH₂), 3046, 3013, 2927, 1611, 1576, 1495, 1472, 1447, 1403, 1295, 1267, 1158.



Sodium nitrite (0.6 g, 8.7 mmol) dissolved in water (25 mL) and cooled at 0°C was added sequentially over 15 min to a stirred solution of diamine 5 (0.9 g, 3.5 mmol) suspended in water (50 mL) containing concentrated hydrochloric acid (12.7 mL) at 0 °C. The clear yellow solution was stirred for 1 h at 0 °C (solution 1). In a separate vessel, a solution of potassium iodide (5.8 g, 35 mmol) in water (64 mL) was cooled to 0°C (solution 2). Solution 1 was added to solution 2 over 15 min at 0°C and the dark red solution was stirred for a further 1 h at 0°C. The ice bath was removed and the mixture was stirred at room temperature for 2 h and then heated to 60°C for a further 2.5 h. The resulting mixture was stirred at room temperature overnight and extracted with dichloromethane (4×100 mL). The organic layers were washed with sodium thiosulfate, water, dried (MgSO₄) and the solvent was removed in *vacuo*. The crude product was purified by column chromatography on silica gel eluting first with light petroleum and second with dichloromethane/light petroleum (1:9). After removal of the solvents, crystallization (light petroleum) affords 0.9 g (53%) of compound 6 as a orange oil; HRMS (APCI-ASAP): m/z: calc for $C_{18}H_{12}I_2Na$: 504.8926; $[M+Na]^+$ found, 504.8927; ¹H NMR (CD₂Cl₂, 300 MHz, ppm) δ = 8.01 – 7.94 (2H, dd, J=8.1 Hz, J=0.6 Hz, ArH), 7.54 - 7.31 (8H, m, ArH), 7.09-7.04 (2H, m, ArH); 13 C NMR (75 MHz; CDCl₃) δ = 146.3 (C), 143.9 (C), 139.4 (CH), 130.2 (CH), 130.1 (CH), 128.9 (CH), 128.5 (CH), 128.1 (CH), 127.5 (CH), 98.6 ppm (C-I); IR (ATR, cm⁻¹) : v = 3048, 2963, 2922,1601, 1578, 1555, 1454, 1428, 1401, 1281, 1268; HRMS (ESI⁺, MeOH/CH₂Cl₂: 9/1): m/z: calc for $C_{18}H_{12}I_2Na : 504.8926; [M+Na]^+, found: 504.8927.$



Compound 6 (0.59 g, 1.20 mmol) was dissolved in dry and degassed THF (40 mL) under an argon atmosphere. The mixture was cooled to -78°C and stirred at this temperature for 10 min. A solution of n-BuLi (1.6 M in hexane, 3.10 mL, 4.90 mmol) was added dropwise in 4 min. The resulting yellow solution was stirred for a further 3.5 min and the 2,7-di-tert-butyl-9-fluorenone (0.80 g, 2.70 mmol), dissolved in dry and degassed THF (40 mL), was added dropwise in 4 min via a canula. The reaction was allowed to stir overnight (from -70°C to room temperature) and the resulting mixture was poured into a saturated solution of ammonium chloride (50 mL) and extracted with dichloromethane and ethyl acetate. The combined extracts were dried (MgSO₄), the solvent was removed in vacuo and the residue was purified by column chromatography on silica gel eluting with dichloromethane/light petroleum (2:8 to 35:65) affords 0.39 g (40%) of compound 7 as a colourless solid; Mp (light petroleum) 290-293°C; HRMS (ESI⁺, MeOH/CH₂Cl₂: 8/2): m/z: calc for C₆₀H₆₂O₂Na : 837.4642; [M+Na]⁺, found: 837.4642; ¹H NMR (DMSO-d6, 300 MHz, ppm) δ 8.28 (2H, d, J=7.8 Hz, ArH), 7.43 (2H, t, J=7.3 Hz, ArH), 7.28 (2H, td, J=7.4, J=1.3 Hz, ArH), 7.22 -7.13 (4H, m, ArH), 7.12 - 7.03 (4H, m, ArH), 6.92 (2H, s, ArH), 6.71 (2H, s, ArH), 6.43 (2H, d, J=7.2 Hz, ArH), 5.67 (2H, s, ex D₂O, OH), 5.65 (1H, t, J=7.2 Hz, ArH), 5.30 (2H, d, J=7.3 Hz, ArH), 4.78 (1H, br, ArH), 1.18 (18H, s, Me), 0.97 (18H, s, Me); ¹³C NMR (DMSO-d⁶, 300 MHz, ppm) : δ 151.3 (C), 151.1 (C), 149.3 (C), 149.0 (C), 140.7 (C), 140.2 (C), 138.3 (C), 137.4 (C), 136.8 (C), 132.4 (CH), 128.5 (CH), 126.32 (CH), 126.26 (CH), 126.0 (CH), 125.6 (CH), 124.9 (CH), 124.6 (CH), 122.7 (CH), 120.8 (CH), 120.4 (CH), 119.1 (CH), 118.8 (CH), 81.2 (COH), 34.4 (<u>C</u>Me), 34.2 (<u>C</u>Me), 31.2 (Me), 30.9 (Me); IR (ATR, cm⁻¹) : v = 3603 (OH), 3447 (C-OH), 3063, 2954, 2901, 2866, 1475, 1438, 1361, 1251, 1166, 1089 (C-O).

In assigning ¹H and ¹³C NMR spectra of molecule **1**, the following numbering is used. The assignments of **1** have been performed by 2D NMR spectroscopy experiments: HMBC (Hetronuclear Multiple Bond Correlation), HMQC (Heteronuclear Multiple Quantum Coherence), ¹H/¹H COSY (Correlation spectroscopy). These 2D spectra are provided below.



The difluorenol **7** (0.2 g, 0.245 mmol) was dissolved in dichloromethane (150 mL) and BF₃OEt₂ (80 μ L) was added dropwise and stirred for 90 min at room temperature. The crude mixture was then evaporated to dryness and purified by column chromatography on silica, eluting with 1. light petroleum, 2. dichloromethane – light petroleum (1:9 to 2:8). The residue was then washed with dichloromethane – hexane to afford the compound **1** as a colourless solid (0.16 g, 85 %);

mp>300°C; (Found: C, 92.3; H, 7.7; C₆₀H₅₈ requires C, 92.5; H, 7.5%); HRMS (APCI-ASAP): m/z: calc for C₆₀H₅₈ : 778.4533; [M]⁺ found: 778.4533; ¹ H NMR (THF-d8, 300MHz, ppm) δ 8.1 (1H, s, H8), 8.02 (2H, d, *J*= 7.6 Hz, H7), 7.57 (4H, d, *J*=8.1 Hz, H3), 7.34 (2H, t, *J*= 7.6 Hz, H6), 7.24 (4H, dd, *J*= 8.1, 1.6 Hz, H2), 7.01 (2H, t, *J*= 7.6 Hz, H5), 7.01 (4H, d, *J*=1.6 Hz, H1), 6.48 (2H, d, *J*=7.6 Hz, H4), 6.14 (1H, s, H9), 1.04 (36H, s, CH₃); ¹³C NMR (THF-d8, 75MHz, ppm) 151.7 (C), 151.4 (C), 150.4 (C), 150.1 (C), 143.3 (C), 142.3 (C), 140.3 (C), 128.6 (CH-5), 128.4 (CH-6), 125.6 (CH-2), 124.6 (CH-4), 121.1 (CH-1), 120.7 (CH-9), 120.6 (CH-7), 120 (CH-3), 112.4 (CH-8), 67 (spiro C), 35.5 (<u>C</u>Me), 32 (Me); IR (ATR, cm⁻¹) : v = 3069, 3040, 3011, 2956, 2917, 2849, 1458, 1443, 1411, 1361, 1268, 1250.

2 D spectra used for the assignment:

- Portion of the 1H/1H COSY spectrum:



- Portion of the HMQC spectrum :



- Different portions of the HMBC spectrum highlighting several key long range shift correlations



ELECTROCHEMICAL STUDIES



Cyclic voltammetry at 100 mV s⁻¹ in CH₂Cl₂/[NBu₄][PF₆] 0.2 M of $\mathbf{1}$: 1.17 10⁻³ M. Three cycles between 0.9 and 2.0 V. Working electrode : Platinum disk, diameter 1 mm.



Cyclic voltammetry at 100 mV s⁻¹ in CH₂Cl₂/[NBu₄][PF₆] 0.2 M of $\mathbf{1}$: 1.17 10⁻³ M. Five cycles between 0.9 and 1.8 V. Working electrode : Platinum disk, diameter 1 mm.



Differential pulse voltammetry at 10 mV s⁻¹ in $CH_2Cl_2 / [NBu_4][PF_6] 0.2$ M of **1** : 1.17 10⁻³ M. Working electrode : Platinum disk, diameter 1 mm.



Cyclic voltammetry at 100 mV s⁻¹ in CH₂Cl₂/[NBu₄][PF₆] 0.2 M of $\mathbf{1}$: 1.17 10⁻³ M. One cycle from 0.375 to 1.6 V then -2.4 V and final potential at 0.375 V. Working electrode: Platinum disk, diameter 1 mm.



Study of a poly(1) modified electrode.

Cyclic voltammetry at 100 mV s⁻¹ in $CH_2Cl_2/[NBu_4][PF_6]$ 0.2 M. Five cycles between 0.9 and 1.8 V. Working electrode : Platinum disk electrode, diameter 1 mm, covered by a poly(1) deposit. The poly(1) electrodeposition was previously performed by multicyclic oxidation including the three oxidation processes.



1 and **poly**(1) (gathering of Figures 2 and 5 for comparison purpose)

OPTICAL STUDIES



Emission spectra at 77K in a frozen toluene matrix of (2,1-*b*)-DSF(*t*-Bu)₄-IF (red line), and (1,2-*b*)-DSF(*t*-Bu)₄-IF (green line). Left: 330/600 nm portion. Right 420/640 nm portion



Emission spectra of (2,1-*b*)-DSF(*t*-Bu)₄-IF (1) at different temperatures in a methylcyclohexane/2-methylpentane 1:1 medium ($\lambda_{exc} = 330$ nm).



Emission spectra of (1,2-*b*)-DSF(*t*-Bu)₄-IF (2) at different temperatures in a methylcyclohexane/2-methylpentane 1:1 medium ($\lambda_{exc} = 330$ nm).



Phosphorescence decay curves of (2,1-*b*)-DSF(*t*-Bu)₄-IF (1) and (1,2-*b*)-DSF(*t*-Bu)₄-IF (2) at 77K in a frozen methylcyclohexane/2-methylpentane 1:1 glassy matrix.



Fluorescence decay curve of (2,1-*b*)-DSF(*t*-Bu)₄-IF (1) at 298K in a THF solution.

THERMAL ANALYSES

The decomposition temperature $(Td, \text{ corresponding to } 5\% \text{ loss})^{15}$ of **1** was examined by means of thermogravimetric analysis (TGA) under a nitrogen atmosphere at a rate of 5°C min⁻¹.



T*d*=387°C

AFM STUDIES

Thin film of (2,1-b)-DSF $(t-Bu)_4$ -IF 1 was prepared by vacuum sublimation on a quartz wafer (Ra = 0.43 nm) at the ENS Cachan. The film was heating gradually from room temperature up to 200°C (RT, 70°C, 100°C, 130°C, 160°C and 200°C) in a Schlenk tube under an ambient atmosphere. For each temperature, the film was cooled until rt (around 10 minutes of cooling) and its topography was analyzed by Atomic Force Microscopy imaging (5 × 5 µm and 1 × 1 µm) using acoustic AC mode with a silicon nitride tip (resonance frequency of 295 kHz), in order to evaluate the effect of thermal stress on the thin film morphology.



COPY OF NMR SPECTRA

Compound 3. (CDCl₃)



Compound 4. (CDCl₃)



Compound 5. (CDCl₃)





^{8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0 5.8 5.6 5.4 5.2 5.0 4.8 4.6 4.4 4.2 4.0 3.8 3.6 3.4 3.2 3.0 2.8 2.6 2.4} 61H



Compound 6. (¹H spectrum in CD₂Cl₂ and ¹³C spectrum in CDCl₃)







115 110 f1 (ppm)

Compound 7. (DMSO-d6)



Compound 1. (THF-d8)









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