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4-{5-(cholesteryloxycarbonyl)butyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-4)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd for $C_{52}H_{76}F_2N_2O_4$, C 75.14, H 9.22, N 3.37 %; found C 75.17, H 9.20, N 3.38 %

4-{6-(cholesteryloxycarbonyl)pentyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-5)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{53}H_{78}F_2N_2O_4$, C 75.32, H 9.30, N 3.31 %; found C 75.31, H 9.33, N 3.30 %

4-{7-(cholesteryloxycarbonyl)hexyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-6)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd for $C_{54}H_{80}F_2N_2O_4$, C 75.48, H 9.38, N 3.26 %; found C 75.49, H 9.38, N 3.27 %

4-{9-(cholesteryloxycarbonyl)octyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-8)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{56}H_{84}F_2N_2O_4$, C 75.81, H 9.54, N 3.16 %; found C 75.80, H 9.56, N 3.17 %

4-{10-(cholesteryloxycarbonyl)nonyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-9)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{57}H_{86}F_2N_2O_4$, C 75.96, H 9.62, N 3.11 %; found C 75.94, H 9.62, N 3.12 %

4-{11-(cholesteryloxycarbonyl)decanoyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-10)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{58}H_{88}F_2N_2O_4$, C 76.11, H 9.69, N 3.06 %; found C 76.12, H 9.70, N 3.06 %

4-{12-(cholesteryloxycarbonyl)undecanoyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-11)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{59}H_{90}F_2N_2O_4$, C 76.25, H 9.76, N 3.01 %; found C 76.25, H 9.75, N 3.02 %

4-{13-(cholesteryloxycarbonyl)dodecanoyloxy}-4'-octyloxy-2',3'-difluoroazobenzene (2) (F-AOC-12)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.67~2.04 (m, CH, CH_2, CH_3), 2.29 (q, O-CH-CH_2), 4.03 (t, CH_2-O), 4.10 (t, CH_2-O), 5.37 (d, C=CH), 6.84 (d, ArCH), 6.99 (d, ArCH), 7.53 (t, ArCH), 7.90 (d, ArCH). FT-IR (KBr, cm^{-1}): 2941 and 2869 (C-H stretching), 1730 (C=O stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{60}H_{92}F_2N_2O_4$, C 76.39, H 9.83, N 2.97 %; found C 76.40, H 9.83, N 2.99 %

4-{4-(1H,1H-perfluorooctyloxy)-2,3-difluorophenylazo}phenol (3)

4-(1H,1H-Pentadecafluorooctyloxy)phenylamine (10.3 g; 21 mmol) was dissolved with heating in a mixture of 60 ml of glacial acetic acid, 30.0 mL of concentrated hydrochloric acid and 30.0 mL of water. After cooling to 0~5℃, diazotization was performed by adding dropwise a solution of $NaNO_2$ (1.86 g; 27 mmol) in 30.0 mL of water to the acid solution. The prepared diazonium salt solution was slowly added to a stirred solution of 2, 3-difluorophenol (3.64 g; 28 mmol), NaOH (3.00g; 75 mmol), Na_2CO_3 (10.1 g; 95 mmol) and 150 ml of water followed by stirring for 1 h at 0-5℃. The yellow-orange to yellow-green colored precipitate was filtered off, dried and purified by chromatography using a silica gel column and CH_2Cl_2 as eluent. Dark brown solid product was obtained, 6.50 g (49.0 %), mp 97 ℃. δ_H (300 MHz; $CDCl_3$; Me_4Si): 4.54 (t, CH_2), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 3100 (ArC-OH stretching), 2941 and 2869 (C-H stretching), 1602 and 1468 (ArC=C stretching), 1248 and 1169 (C-O stretching). Elemental analysis: calcd. for $C_{20}H_9F_{17}N_2O_2$, C 37.99, H 1.43, N 4.43 %; found C 38.00, H 1.44, N 4.45 %

4-{8-(cholesteryloxycarbonyl)heptyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-7)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{55}H_{67}F_{17}N_2O_4$ C 57.79, H 5.91, N 2.45 %; found C 57.78, H 5.91, N 2.46 %

4-{5-(cholesteryloxycarbonyl)butyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-4)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -

OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{52}H_{61}F_{17}N_2O_4$ C 56.73, H 5.58, N 2.54 %; found C 56.73, H 5.58, N 2.56 %

4-{6-(cholesteryloxycarbonyl)pentyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-5)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{53}H_{63}F_{17}N_2O_4$, C 57.09, H 5.69, N 2.51 %; found C 57.10, H 5.70, N 2.52 %

4-{7-(cholesteryloxycarbonyl)hexyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-6)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{54}H_{65}F_{17}N_2O_4$ C 57.44, H 5.80, N 2.48 %; found C 57.44, H 5.80, N 2.48 %

4-{9-(cholesteryloxycarbonyl)octyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-8)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm-1): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{56}H_{69}F_{17}N_2O_4$, C 58.13, H 6.01, N 2.42 %; found C 58.11, H 6.00, N 2.43 %

4-{10-(cholesteryloxycarbonyl)nonyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-9)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{57}H_{73}F_{17}N_2O_4$, C 58.46, H 6.11, N 2.39 %; found C 58.46, H 6.10, N 2.39 %

4-{11-(cholesteryloxycarbonyl)decanoyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-10)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{58}H_{73}F_{17}N_2O_4$ C 58.78, H 6.21, N 2.36 %; found C 58.78, H 6.21, N 2.36

4-{12-(cholesteryloxycarbonyl)undecanoyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-11)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{59}H_{75}F_{17}N_2O_4$, C 59.09, H 6.30, N 2.34 %; found C 59.10, H 6.33, N 2.34 %

4-{13-(cholesteryloxycarbonyl)dodecanoyloxy}-4'-perfluorooctyloxy-2',3'-difluoroazobenzene (4) (F-AOCF-12)

δ_H (300 MHz; $CDCl_3$; Me_4Si): 0.60~1.91 (m, CH, CH_2, CH_3), 2.27 (m, -C=C-CH_2-, -O-CO-CH_2-), 4.54 (m, -CF_2CH_2Ar, -OCH-), 5.36 (m, -C=CH-), 6.78 (t, Ar-H), 7.05 (d, Ar-H), 7.52 (t, Ar-H), 7.93 (d, Ar-H). FT-IR (KBr, cm^{-1}): 2941 and 2868 (aliphatic C-H stretching), 1737 (C=O stretching), 1587 (aromatic C=C stretching), 1246 and 1145 (C-O stretching). Elemental analysis: calcd. for $C_{60}H_{77}F_{17}N_2O_4$, C 59.40, H 6.40, N 2.31 %; found C 59.39, H 6.38, N 2.33 %