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Unexpected formation of substituted naphthalenes and phenanthrenes in a $GaCl_3$ mediated dimerization–fragmentation reaction of 2-arylcyclopropane-1,1-dicarboxylates

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2-Chloro-6-(3-chlorophenyl)naphthalene **2d.**

Yield 65%. Thick colourless oil. IR ($CHCl_3$) ν 3020, 2967, 2923, 1479, 1422 cm^{-1}. ^1H NMR ($CDCl_3$, 400.1 MHz): δ 7.36 (ddd, 1H, H(4′), ^3J = 8.1 Hz, ^4J = 1.9 and 1.2 Hz), 7.41 (dd, 1H, H(5′), ^3J = 8.1 and 7.5 Hz), 7.46 (dd, 1H, H(3), ^3J = 8.7 Hz, ^4J = 2.0 Hz), 7.57 (ddd, 1H, H(6′), ^3J = 7.5 Hz, ^4J = 1.7 and 1.2 Hz), 7.68 (dd, 1H, H(2′), ^4J = 1.9 and 1.7 Hz), 7.72 (dd, 1H, H(7), ^3J = 8.5 Hz, ^4J = 1.8 Hz), 7.81–7.85 (m, 2H, H(4) and H(8)), 7.85 (d, 1H, H(1), ^4J = 2.0 Hz), 7.98 (br.s, 1H, H(5)). ^{13}C NMR ($CDCl_3$, 100.6 MHz): δ 125.6 (HC(6′)), 126.0 (HC(5)), 126.4 (HC(7)), 126.5 (HC(1)), 127.56 (HC(3)), 127.59 (HC(2′)), 127.67 (HC(4′)), 127.9 (HC(8)), 129.9 (HC(4)), 130.2 (HC(5′)), 131.9 (C(4a)), 132.1 (C(2)), 133.5 (C(8a)), 135.0 (C(3′)), 137.6 (C(6)), 142.7 (C(1′)). MS (*m/z*, %): 272 (90) $[M]^+$ for ^{35}Cl, 232 (15), 202 (66), 149 (35), 100 (30), 83 (33), 59 (52), 57 (77), 43 (100). Found (%): C, 70.29; H, 3.88. Calc. for $C_{16}H_{10}Cl_2$ (%): C, 70.35; H, 3.69.

2-Bromo-6-(3-bromophenyl)naphthalene **2e**.

Yield 67%. Thick colourless oil. IR ($CHCl_3$) ν 3020, 2956, 2923, 1588, 1479, 1420 cm^{-1}. ^1H NMR ($CDCl_3$, 400.1 MHz): δ 7.35 (dd, 1H, H(5′), ^3J = 8.0 and 7.8 Hz), 7.51 (ddd, 1H, H(4′), ^3J = 8.0 Hz, ^4J = 1.9 and 1.0 Hz), 7.59 (dd, 1H, H(3), ^3J = 8.7 Hz, ^4J = 2.0 Hz), 7.62 (ddd, 1H, H(6′), ^3J = 7.8 Hz, ^4J = 1.7 and 1.0 Hz), 7.71 (dd, 1H, H(7), ^3J = 8.6 Hz, ^4J = 1.8 Hz), 7.76 (d, 1H, H(4), ^3J = 8.7 Hz), 7.83 (d, 1H, H(8), ^3J = 8.6 Hz), 7.84 (dd, 1H, H(2′), ^4J = 1.9 and 1.7 Hz), 7.97 (d, 1H, H(5), ^4J = 1.8 Hz), 8.03 (d, 1H, H(1), ^4J = 2.0 Hz). ^{13}C NMR ($CDCl_3$, 100.6 MHz): δ 120.3 (C(2)), 123.2 (C(3′)), 126.1 (HC(5) and HC(6′)), 126.4 (HC(7)), 127.8 (HC(8)), 129.8 (HC(1)), 129.9 (HC(4)), 130.0 (HC(3)), 130.5 (HC(2′) and HC(5′)), 130.6 (HC(4′)), 132.1 (C(4a)), 134.0 (C(8a)), 137.6 (C(6)), 142.9 (C(1′)). MS (*m/z*, %): 364 (50) $[M]^+$ for ^{81}Br, 202 (100), 174 (9), 150 (15), 126 (9), 101 (48), 88 (20), 75 (21), 63 (17), 50 (22). Found (%): C, 52.85; H, 2.75. Calc. for $C_{16}H_{10}Br_2$ (%): C, 53.08; H, 2.78.