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SUPPLEMENTARY MATERIAL TO  
**Phosphosulfonic acid, an efficient solid acid catalyst for the  
one-pot preparation of 14-aryl-14*H*-dibenzo[*a,j*]xanthenes  
and 1,8-dioxooctahydroxanthenes under  
solvent-free conditions**

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SPECTROSCOPIC DATA FOR THE PREPARED XANTHENES

*14-Phenyl-14H-dibenzo[*a,j*]xanthene (3a)*. IR (KBr,  $\text{cm}^{-1}$ ): 3068, 3020, 2885, 1620, 1590, 1512, 1488, 1457;  $^1\text{H-NMR}$  (400 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 8.70 (2H, *d*,  $J = 8.8$  Hz), 7.91–7.93 (4H, *m*), 7.62–7.66 (4H, *m*), 7.57 (2H, *d*,  $J = 8.8$  Hz), 7.45 (2H, *t*,  $J = 7.2$  Hz), 7.14 (2H, *t*,  $J = 7.6$  Hz), 6.97 (1H, *t*,  $J = 7.6$  Hz), 6.74 (1H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 148.5, 146.0, 131.4, 131.1, 129.5, 129.1, 128.8, 128.4, 127.4, 126.7, 124.9, 123.9, 124.9, 123.9, 118.2, 117.9, 37.0.

*14-(4-Nitrophenyl)-14H-dibenzo[*a,j*]xanthene (3b)*. IR (KBr,  $\text{cm}^{-1}$ ): 3070, 2930, 1621, 1591, 1614, 1457, 1400, 1340;  $^1\text{H-NMR}$  (400 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 8.72 (2H, *d*,  $J = 8.4$  Hz), 8.45 (1H, *s*), 8.14 (1H, *d*,  $J = 7.8$  Hz), 7.90–7.95 (4H, *m*), 7.81 (1H, *d*,  $J = 7.5$  Hz), 7.58–7.65 (4H, *m*), 7.43 (3H, *t*,  $J = 7.2$  Hz), 6.95 (1H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 148.6, 148.3, 147.9, 134.7, 131.11, 130.4, 130.0, 129.1, 127.7, 125.2, 123.6, 122.0, 118.2, 116.9, 36.4.

*14-(4-Methylphenyl)-14H-dibenzo[*a,j*]xanthene (3e)*. IR (KBr,  $\text{cm}^{-1}$ ) 3020, 2908, 1620, 1591, 1509, 1457, 1430, 1247, 959, 837, 810, 739;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 8.36 (2H, *d*,  $J = 9.4$  Hz), 7.32–7.80 (12H, *m*), 6.90 (2H, *d*,  $J = 9.6$  Hz), 6.39 (1H, *s*), 2.18 (3H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 147.9, 147.8, 142.5, 135.9, 130.8, 128.8, 128.4, 127.7, 126.7, 124.3, 123.3, 117.5, 117.4, 117.3, 37.1, 20.2.

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*14-(4-Chlorophenyl)-14H-dibenzo[a,j]xanthene (3f)*. IR (KBr,  $\text{cm}^{-1}$ ): 3033, 1618, 1580;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.10–8.34 (16H, *m*, Ar), 6.48 (1H, *s*, CH);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 148.7, 143.5, 132.1, 131.24, 131.0, 129.5, 129.1, 128.9, 128.6, 126.9, 124.4, 122.4, 118.0, 116.7, 37.4.

*14-(2-Nitrophenyl)-14H-dibenzo[a,j]xanthene (3g)*. IR (KBr,  $\text{cm}^{-1}$ ): 3400, 3058, 1593, 1523, 1350, 1240, 1142, 810, 748;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.52 (1H, *s*) 7.10–8.70 (16H, *m*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 149.8, 147.5, 141.3, 134.5, 132.6, 132.1, 130.8, 129.9, 129.5, 129.4, 128.0, 127.8, 125.3, 125.0, 124.6, 123.0, 118.4, 118.0, 32.9.

*14-(4-Hydroxyphenyl)-14H-dibenzo[a,j]xanthene (3h)*. IR (KBr,  $\text{cm}^{-1}$ ): 3404, 1592, 1511, 1401, 1250, 1242, 816;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 6.56–8.36 (16H, *m*, Ar-H), 6.42 (1H, *s*, CH), 4.97 (1H, *brs*, OH);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 154.2, 149.1, 137.9, 131.8, 131.5, 129.8, 129.2, 129.1, 127.2, 124.6, 123.1, 118.4, 117.9, 115.7, 37.5.

*14-(4-(Trifluoromethyl)phenyl)-14H-dibenzo[a,j]xanthene (3i)*. IR (KBr,  $\text{cm}^{-1}$ ): 3021, 2919, 1591, 1513, 1458;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 8.33 (2H, *d*,  $J = 8.4$  Hz), 7.82–7.86 (4H, *m*), 7.58–7.65 (4H, *m*), 7.50 (2H, *d*,  $J = 8.8$  Hz), 7.39–7.46 (4H, *m*), 6.61 (1H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 148.8, 131.2, 131.1, 129.3, 129.0, 128.5, 127.0, 125.54, 125.50, 124.5, 122.3, 118.0, 116.4, 37.8.

*14-(3-Fluorophenyl)-14H-dibenzo[a,j]xanthene (3k)*. IR (KBr,  $\text{cm}^{-1}$ ): 3154, 1594, 1403, 1240, 1207, 1069, 817, 747;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 6.72–8.38 (16H, *m*), 6.51 (1H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm) 165.0, 161.7, 149.2, 147.8 ( $J_{\text{C-F}} = 6.2$  Hz), 131.6 ( $J_{\text{C-F}} = 19.4$  Hz), 130.1 ( $J_{\text{C-F}} = 8.3$  Hz), 129.5, 129.3, 127.4, 124.8, 124.3 ( $J_{\text{C-F}} = 2.8$  Hz), 122.9, 118.2, 117.1, 115.7 ( $J_{\text{C-F}} = 21.5$  Hz), 113.9 ( $J_{\text{C-F}} = 21.5$  Hz), 38.1.

*14-(4-Methoxyphenyl)-14H-dibenzo[a,j]xanthene (3l)*. IR (KBr,  $\text{cm}^{-1}$ ): 2999, 2833, 1734, 1591, 1508, 1457;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 8.35 (2H, *d*,  $J = 9.6$  Hz), 7.32–7.85 (12H, *m*), 6.65 (2H, *d*,  $J = 9.7$  Hz), 6.40 (1H, *s*), 3.58 (3H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 158.2, 149.3, 137.2, 133.7, 131.4, 129.4, 129.1, 127.4, 124.1, 123.5, 118.3, 117.2, 114.3, 53.2, 36.9.

*3,4,5,6,7,9-Hexahydro-3,3,6,6-tetramethyl-9-phenyl-1H-xanthene-1,8(2H)-dione (5a)*. IR (KBr,  $\text{cm}^{-1}$ ): 3032, 2952, 1670, 1471;  $^1\text{H-NMR}$  (400 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 7.21 (2H, *t*,  $J = 7.20$  Hz), 7.18 (2H, *d*,  $J = 7.0$  Hz), 7.10 (1H, *t*,  $J = 7.0$  Hz), 2.58 (2H, *d*,  $J = 17.7$  Hz), 4.53 (1H, *s*), 2.53 (2H, *d*,  $J = 17.1$  Hz), 2.27 (2H, *d*,  $J = 16.2$  Hz), 2.09 (2H, *d*,  $J = 16.1$  Hz), 1.04 (6H, *s*), 0.90 (6H, *s*);  $^{13}\text{C-NMR}$  (100 MHz,  $\text{DMSO-}d_6$ ,  $\delta$  / ppm): 196.8, 162.7, 144.5, 128.8, 128.4, 126.8, 116.1, 51.2, 41.3, 32.6, 32.3, 29.6, 27.7.

*3,4,5,6,7,9-Hexahydro-3,3,6,6-tetramethyl-9-(4-nitrophenyl)-1H-xanthene-1,8(2H)-dione (5b)*. IR (KBr,  $\text{cm}^{-1}$ ): 3032, 2960, 1664, 1462;  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 8.08 (2H, *d*,  $J = 8.2$  Hz), 7.48 (2H, *d*,  $J = 8.2$  Hz), 4.83

(1H, *s*), 2.51 (4H, *t*,  $J = 18.7$  Hz), 2.26 (2H, *d*,  $J = 16.3$  Hz), 2.16 (2H, *d*,  $J = 16.3$  Hz), 1.12 (6H, *s*), 0.99 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.7, 163.5, 152.0, 146.8, 129.8, 123.8, 114.9, 51.0, 41.2, 32.8, 32.6, 29.6, 27.7.

*3,4,5,6,7,9-Hexahydro-3,3,6,6-tetramethyl-9-(3-nitrophenyl)-1H-xanthene-1,8(2H)-dione (5c)*. IR (KBr,  $\text{cm}^{-1}$ ): 3021, 2962, 1662, 1466, 1363;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 8.06 (1H, *s*), 7.99 (1H, *d*,  $J = 8.2$  Hz), 7.81 (1H, *d*,  $J = 7.5$  Hz), 7.41 (1H, *t*,  $J = 7.9$  Hz), 4.85 (1H, *s*), 2.53 (4H, *t*,  $J = 18.5$  Hz), 2.27 (2H, *d*,  $J = 16.3$  Hz), 2.18 (2H, *d*,  $J = 16.3$  Hz), 1.13 (6H, *s*), 1.01 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.8, 163.5, 148.7, 146.8, 136.0, 129.2, 123.1, 122.0, 114.9, 51.0, 41.2, 32.7, 32.5, 29.6, 27.7.

*3,4,5,6,7,9-Hexahydro-3,3,6,6-tetramethyl-9-(2-nitrophenyl)-1H-xanthene-1,8(2H)-dione (5d)*. IR (KBr,  $\text{cm}^{-1}$ ): 3026, 2964, 1662, 1471, 1361;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.21–7.73 (4H, *m*, Ar-H), 5.51 (1H, *s*), 2.45 (4H, *s*), 2.21 (2H, *d*,  $J = 16.2$  Hz), 2.13 (2H, *d*,  $J = 16.2$  Hz), 1.07 (6H, *s*), 0.98 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.7, 163.4, 150.3, 138.5, 132.4, 131.5, 127.6, 125.0, 114.6, 51.0, 41.3, 32.5, 29.4, 29.2, 28.0.

*3,4,5,6,7,9-Hexahydro-3,3,6,6-tetramethyl-9-(4-methylphenyl)-1H-xanthene-1,8(2H)-dione (5e)*. IR (KBr,  $\text{cm}^{-1}$ ): 3021, 2961, 1662, 1466;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.20 (2H, *d*,  $J = 6.9$  Hz), 7.04 (2H, *d*,  $J = 7.5$  Hz), 4.74 (1H, *s*), 2.49 (4H, *s*), 2.17–2.27 (7H, *m*), 1.25 (6H, *s*), 1.02 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.8, 162.5, 141.6, 136.1, 129.2, 128.7, 116.2, 51.2, 41.3, 32.6, 31.9, 29.7, 27.8, 21.5.

*3,4,5,6,7,9-Hexahydro-9-(4-methylphenyl)-3,3,6,6-tetramethyl-1H-xanthene-1,8(2H)-dione (5f)*. IR (KBr,  $\text{cm}^{-1}$ ): 3031, 2959, 1665, 1460, 1361, 1200, 1170, 855;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.22 (2H, *d*,  $J = 8.8$  Hz), 6.77 (2H, *d*,  $J = 8.8$  Hz), 4.72 (1H, *s*), 3.75 (3H, *s*), 2.48 (4H, *s*), 2.25 (2H, *d*,  $J = 16.4$  Hz), 2.18 (2H, *d*,  $J = 16.4$  Hz), 1.12 (6H, *s*), 1.01 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.5, 162.1, 157.9, 136.5, 129.3, 115.8, 113.5, 55.1, 50.8, 40.9, 32.2, 30.9, 29.3, 27.3.

*9-(4-Chlorophenyl)-3,4,5,6,7,9-hexahydro-3,3,6,6-tetramethyl-1H-xanthene-1,8(2H)-dione (5g)*. IR (KBr,  $\text{cm}^{-1}$ ): 3018, 2971, 1661, 1466;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 7.09–7.46 (*m*, 4H, Ar-H), 5.03 (1H, *s*), 2.48 (4H, *s*), 2.26 (2H, *d*,  $J = 16.2$  Hz), 2.19 (2H, *d*,  $J = 16.2$  Hz), 1.13 (6H, *s*), 1.05 (6H, *s*);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.8, 163.4, 140.3, 133.9, 133.3, 130.6, 128.2, 126.7, 114.1, 51.1, 41.2, 32.4, 32.3, 29.7, 27.8.

*4-(2,3,4,5,6,7,8,9-Octahydro-3,3,6,6-tetramethyl-1,8-dioxo-1H-xanthene-9-yl)benzotrile (5h)*. IR (KBr,  $\text{cm}^{-1}$ ): 3015, 2960, 2224, 1662, 1500, 1471;  $^1\text{H}$ -NMR (400 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 0.98 (6H, *s*,  $2 \times \text{CH}_3$ ), 1.11 (6H, *s*,  $2 \times \text{CH}_3$ ), 2.13–2.26 (4H, *dd*,  $J = 19.6$  Hz,  $2 \times \text{CH}_2$ ), 2.49 (4H, *t*,  $2 \times \text{CH}_2$ ), 4.76 (1H, *s*), 7.40–7.51 (4H, *dd*,  $J = 4.9$  Hz, Ar-H);  $^{13}\text{C}$ -NMR (100 MHz,  $\text{CDCl}_3$ ,  $\delta$  / ppm): 196.3, 163.0, 149.5, 131.9, 129.3, 119.0, 114.5, 110.1, 50.6, 40.8, 32.5, 32.2, 29.2, 27.3.