

A novel magnetic NiFe₂O₄@graphene-Pd multifunctional nanocomposite for practical catalytic application

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Characterization of Products

4-methoxybiphenyl (Table 1, entry 1 and 3):

White solid, ¹H NMR (300 MHz, CDCl₃): δ (ppm): 7.57-7.52 (m, 4H), 7.45-7.40 (m, 2H), 7.33-7.26 (m, 1H), 6.98 (m, 2H), 3.86 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 159.1, 140.8, 133.7, 128.7, 128.1, 126.7, 126.6, 114.2, 55.3. Anal. Calcd. For C₁₃H₁₂O: C, 84.75%; H, 6.57%. Found: C, 84.76%; H, 6.55%

(Known compound, see: E. Shirakawa, Y. Hayashi, K.I. Itoh, R. Watabe, N. Uchiyama, W. Konagaya, S. Masui, T. Hayashi, *Angew. Chem. Int. Ed.*, **2012**, *51*, 218.).

4-nitrobiphenyl (Table 1, entry 2, 6, 8 and 9):

Pale yellow solid, ¹H NMR (300 MHz, CDCl₃): δ (ppm): 8.30 (d, *J* = 8.2 Hz, 2H), 7.73 (d, *J* = 8.9 Hz, 2H), 7.64-7.61 (m, 2H), 7.53-7.42 (m, 3H); ¹³C NMR (100 MHz, CDCl₃): 124.2, 127.5, 127.9, 129.0, 129.3, 138.9, 146.1, 147.8. Anal. Calcd. For C₁₂H₉NO₂: C, 72.35%; H, 4.55%; N, 7.03%. Found: C, 72.36%; H, 4.57%; N, 7.02%.

(Known compound, see: V. Percec, G.M. Golding, J. Smidrkal, O. Weichold, *J. Org. Chem.*, **2004**, *69*, 3447.).

4-methylbiphenyl (Table 1, entry 4 and 12)

White solid, ¹H NMR (400 MHz, CDCl₃): δ 2.60 (s, 3H), 7.45 (d, *J* = 8.0 Hz, 2H), 7.53 (t, *J* = 7.20 Hz, 1H), 7.63 (t, *J* = 7.6 Hz, 2H), 7.72 (d, *J* = 8.0 Hz, 2H), 7.80 (d, *J* = 7.6 Hz, 2H); ¹³C NMR (100 MHz, CDCl₃): 21.2, 127.1, 127.1, 127.3, 128.8, 128.9, 137.2, 138.5, 141.3; Anal. Calcd. For C₁₃H₁₂: C, 92.81%; H, 7.19%. Found: C, 92.83%; H, 7.17%

(Known compound, see: V. Percec, G.M. Golding, J. Smidrkal, O. Weichold, *J. Org. Chem.*, **2004**, *69*, 3447.)

4-acetylbiphenyl (Table 1, entry 5 and 10):

White solid, ¹H NMR (300 MHz, CDCl₃): δ (ppm): 8.05-8.02 (m, 2H), 7.70-7.62 (m, 4H), 7.50-7.40 (m, 3H), 2.64 (s, 3H); ¹³C NMR (100 MHz, CDCl₃): 26.8, 127.3, 127.4, 128.4, 129.0, 129.1, 135.9, 139.9, 145.9, 197.9. Anal. Calcd. for C₁₄H₁₂O: C, 85.68%; H, 6.16%. Found: C, 85.65%; H, 6.17%.

(Known compound, see: V. Percec, G.M. Golding, J. Smidrkal, O. Weichold, *J. Org. Chem.*, **2004**, *69*, 3447.)

2-methoxybiphenyl (Table 1, entry 7):

White solid; ¹H NMR (500 MHz, CDCl₃): δ 3.875 (3H, s), 7.00-7.07 (2H, m), 7.30-7.35 (3H, m), 7.40-7.42 (2H, m), 7.52-7.56 (2H, m); ¹³C NMR: δ 55.5, 111.1, 120.8, 126.9, 127.9, 128.6, 129.5, 130.6, 130.9, 138.5, 156.4. Anal. Calcd. For C₁₃H₁₂O: C, 84.75%; H, 6.57%. Found: C, 84.76%; H, 6.55%.

(Known compound, see: T. Liu, X. Zhao, Q. Shen, L. Lu, *Tetrahedron*, **2012**, *68*, 6535.)

4-Carbaldehydebiphenyl (Table 1, entry 11):

White solid; ¹H NMR (500 MHz, CDCl₃): δ 10.06 (s, 1H), 7.97 (d, *J* = 8.4 Hz, 2H), 7.76 (d, *J* = 8.1 Hz, 2H), 7.64 (d, *J* = 7.5 Hz, 2H), 7.46 (m, 3H). ¹³C NMR (CDCl₃, 100 MHz) δ 192.6, 147.5, 140.0, 135.5, 130.5, 129.3, 128.7, 127.9, 127.6. Anal. Calcd. For C₁₃H₁₀O: C, 85.69%; H, 5.53%. Found: C, 85.72%; H, 5.50%