Electronic Supplementary Material (ESI) for Catalysis Science & Technology

Cu-grafted mesoporous organic polymer: A new recyclable nanocatalyst for multi-component, N-arylation and S-arylation reactions

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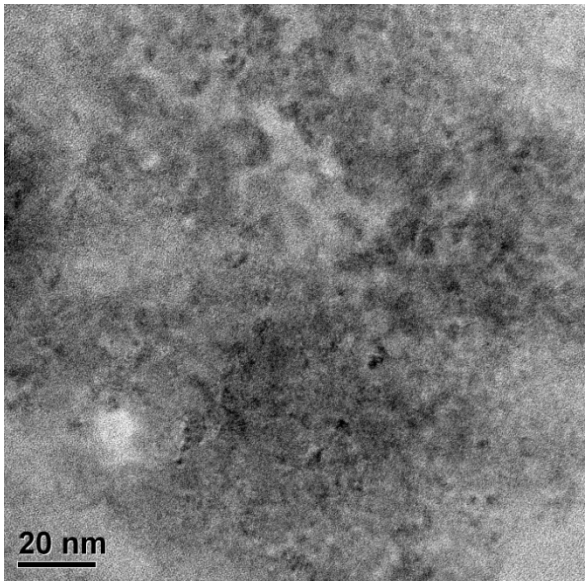

Figure S1. HR TEM image of Cu-MPTA-1 catalyst after the catalytic reaction.

Spectral data of the isolated product:

N-Arylation of imidazoles with different aryl:

1-phenyl-1H-imidazole[1]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.84 (s, 1H), 7.47-7.50 (m, 2H), 7.37-7.41 (m, 3H), 7.29 (s, 1H), 7.22 (s, 1H)

1-(4-Methylphenyl)-1H-imidazole[1]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.76 (s, 1H), 7.25(m, 4H), 7.17 (bs, 1H), 7.17 (bs, 1H), 2.39 (s, 3H)

1-(4-Methoxyphenyl)-1H-imidazole[2]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.72 (s, 1H), 7.28 (d, 2H), 7.15 (bs, 1H), 7.10 (bs, 1H), 6.98 (d, 2H), 3.80 (s, 3H)

1-(4-(1H-Imidazol-1-yl) phenyl) ethanone[1]

^{1}HNMR (400MHz, $CDCl_3$): δ= 8.04 (d, 2H), 7.97 (bs, 1H), 7.50 (d, 2H), 7.35 (bs, 1H), 7.20 (bs, 1H), 2.65 (s, 3H)

1-(4-Nitrophenyl)-1H-imidazole[1]

^{1}H NMR (400MHz, $CDCl_3$): δ= 8.39 (d, 2H), 7.98 (bs, 1H), 7.60 (d, 2H), 7.40 (bs, 1H), 7.28 (bs, 1H)

1-o-Tolyl-1H-imidazole[1]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.55 (bs, 1H), 7.37–7.24 (m, 3H), 7.22–7.17 (m, 2H), 7.09 (bs, 1H), 2.20 (s, 3H)

C-S coupling reaction of Thiophenol with Aryl iodide:

diphenyl sulfide[3]

^{1}H NMR (400MHz, $CDCl_3$): δ = 7.20-7.34 (m, 10H)

4-methylphenyl phenyl sulfide[4]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.28-7.15 (m, 7H), 7.12 (d, 2H), 2.30 (s, 3H)

4-methoxyphenyl phenyl sulfide[5]

^{1}H NMR (400 MHz, $CDCl_3$): d = 3.78 (s, 3 H), 6.90 (d, 2H), 7.08-7.22 (m, 5 H), 7.42 (d, 2 H)

4-Nitrophenyl phenyl sulfide[6]

^{1}H NMR (400MHz, $CDCl_3$): δ= 7.14 (d, 2H), 7.44-7.46 (m, 3H), 7.46-7.55 (m, 2H), 8.04 (d, 2H)

4-bromophenyl phenyl sulfide[4]

^{1}H NMR (200MHz, $CDCl_3$): δ= 7.50-7.14 (m, 9H)

4-chlorophenyl phenyl sulfide[4]

^{1}H NMR (200MHz, $CDCl_3$): δ= 7.37-7.25 (m, 9H)

2-Phenylsulfanylaniline[4]

^{1}H NMR (200MHz, $CDCl_3$): δ= 7.45-7.40 (m, 1H), 7.25-7.06 (m, 6H), 6.78-6.73 (m, 2H), 3.98 (br, 2H)

3-(phenylthio) pyridine[6]

^{1}H NMR (400 MHz, $CDCl_3$): δ= 7.12-7.14 (m, 1 H), 7.14-7.30 (m, 5 H), 7.50-7.53 (m, 1 H), 8.39-8.43 (m, 1 H), 8.50 (s, 1 H)

The three-component (A^3) coupling reaction:

1-(1-Cyclohexyl-3-phenyl-2-propynyl]piperidine.[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): *δ* 7.46-7.44 (m, 2H), 7.30-7.24 (m, 3H), 3.09 (d, 1H), 2.65-2.60 (m, 2H), 2.44-2.40 (m, 2H), 2.14-2.04 (m, 2H), 1.80-1.70 (m, 2H), 1.65-1.51(m, 6H), 1.45-1.40 (m, 2H), 1.34-1.15 (m, 3H), 1.07-0.88 (m, 2H).

N-(1-Isopropyl-3-phenyl-2-propynyl) piperidine[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.47–7.44 (m, 2H), 7.34–7.30 (m, 3H), 3.01 (d, 1H), 2.69–2.65 (m, 2H), 2.43 (br, 2H), 1.97-1.93 (m, 1H), 1.68–1.57 (m, 4H), 1.49–1.46 (m, 2H), 1.10 (d, 3H), 1.02 (d, 3H).

1-[1-(1-Ethylpropyl)-3-phenyl-2-propynyl] piperidine[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.44-7.41 (m, 2H), 7.33-7.23 (m, 3H), 3.21 (d, 1H), 2.65-2.61 (m, 2H), 2.43-2.39 (m, 2H), 1.78-1.65 (m, 1H), 1.61-1.50 (m, 6H), 1.51-1.40 (m, 4H), 0.91 (t, 3H), 0.83 (t, 3H)

N-(3-Phenyl)-prop-2-ynyl) piperidine[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.44-7.42 (m, 2H), 7.31-7.28 (m, 3H), 3.47 (s, 2H), 2.56 (br, 4H), 1.69-1.60 (m, 4H), 1.45 (br, 2H).

1-(1-phenylhept-1-yn-3-yl) piperidine[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.44-7.40 (m, 2H), 7.30-7.27 (m, 3H), 3.48-3.45 (d, 1H), 2.70-2.65 (m, 2H), 2.50-2.45 (m, 2H), 1.76-1.60 (m, 6H), 1.61-1.50 (m, 3H), 1.51-1.25 (m, 7H), 0.90-0.86 (t, 3H)

1-(5-cyclohexyl-1-phenylpent-1-yn-3-yl) piperidine[7]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.42-7.41 (m, 2H), 7.30-7.25 (m, 3H), 3.49-3.46 (t, 1H), 2.70-2.65 (m, 2H), 2.47 (br, 2H), 1.75-1.53 (m, 10H), 1.51-1.40 (m, 3H), 1.36-1.08 (m, 6H), 0.96-0.87 (m, 2H)

1-(1,3-Diphenylprop-2-ynyl)pyrrolidine[8]

^{1}HNMR ($CDCl_3$, 500MHz, ppm): δ= 1.83 (s, 4H), 2.74 (s, 4H), 4.91 (s, 1H), 7.32–7.35 (m, 4H), 7.40 (t, 2H), 7.50–7.52 (m, 2H), 7.64-7.66 (m, 2H).

1-(1-(4-Methoxyphenyl)-3-phenylprop-2-ynyl) pyrrolidine[8]

^{1}H NMR ($CDCl_3$, 500MHz, ppm): δ= 1.81 (m, 4H), 2.71 (m, 4H), 3.83 (s, 3H), 4.85 (s, 1H), 6.90 (d, 2H), 7.35 (m, 3H), 7.51–7.52 (m, 2H), 7.52–7.55 (m, 2H).

1-(1-(4-Chlorophenyl)-3-phenylprop-2-ynyl) pyrrolidine[8]

^{1}H NMR ($CDCl_3$, 500MHz, ppm): δ= 1.82 (m, 4H), 2.71 (m, 4H), 4.90 (s, 1H), 7.34–7.37 (m, 5H), 7.50–7.53 (m, 2H), 7.57–7.60 (m, 2H).

1-[1-Cyclohexyl-3-phenyl-2-propynyl] pyrrodine[8]

^{1}H-NMR ($CDCl_3$, 400MHz, ppm): δ= 7.43-7.42 (m, 2H), 7.31-7.24 (m, 3H), 3.33 (d, 1H), 2.74-2.70 (m, 2H), 2.64-2.63 (m, 2H), 2.08 (d, 1H), 1.94 (d, 1H), 1.75-1.74 (m, 6H), 1.68-1.64 (m, 1H), 1.60-1.51 (m, 1H), 1.31-1.04 (m, 5H).

1-[1-Cyclohexyl-3-(4-methylphenyl)-2-propynyl] piperidine[9]

^{1}H-NMR ($CDCl_3$, 400MHz): δ 7.30 (d, 2H), 7.06 (d, 2H), 3.08 (d, 1H), 2.66-2.58 (m, 2H), 2.40-2.32 (m, 2H), 2.30 (s, 3H), 2.10-1.96 (m, 2H), 1.77-1.67 (m, 2H), 1.64-1.47 (m, 6H), 1.44-1.35 (m, 2H), 1.31-1.10(m, 3H), 1.06-0.88 (m, 2H)

1-(1-cyclohexyl-3-(4-methoxyphenyl) prop-2-ynyl) piperidine[7]

^{1}H-NMR (400MHz, $CDCl_3$): δ= 7.36 (d, 2H), 6.80 (d, 2H), 3.81 (s, 3H), 3.07 (d, 1H), 2.65-2.58 (m, 2H), 2.38 (br, 2H), 2.10-2.02 (m, 2H), 1.76-1.56 (m, 8H), 1.45-1.40 (m, 2H), 1.30-1.01 (m, 3H), 1.00-0.86 (m, 2H)

1-(1-cyclohexyl-3-(3-methoxyphenyl) prop-2-ynyl) piperidine[7]

^{1}H-NMR (400MHz, $CDCl_3$): δ= 7.20-7.17 (m, 1H), 7.05 (d, 1H), 6.97 (d, 1H), 6.81-6.80 (d, 1H), 3.81 (s, 3H), 3.10(d, 1H), 2.63-2.58 (m, 2H), 2.38 (br, 2H), 2.10-2.01(m, 2H), 1.76-1.53 (m, 8H), 1.45-1.40 (m, 2H), 1.31-1.01 (m, 3H), 1.01-0.85 (m, 2H)

1-(3-(4-chlorophenyl)-1-cyclohexylprop-2-ynyl) piperidine[7]

^{1}H-NMR (400MHz, $CDCl_3$): δ= 7.34 (d, 2H), 7.27 (d, 2H), 3.07 (d, 1H), 2.60-2.57(m, 2H), 2.36 (br, 2H), 2.07-2.00 (m, 2H), 1.84-1.73 (m, 2H), 1.66-1.50 (m, 6H), 1.45-1.40 (m, 2H), 1.32-1.13 (m, 3H), 1.04-0.85 (m, 2H)

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