## A Multicomponent Synthesis of 2-Amino-3-cyanopyridine Derivatives Catalyzed by Heterogeneous and Recyclable Copper Nanoparticles on Charcoal

## Reza Khalifeh\* and Mahdiyeh Ghamari

Department of Chemistry, Shiraz University of Technology, 71555-313 Shiraz, Iran



Figure S1. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 1.



Figure S2. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 1.

```
*e-mail: khalifeh@sutech.ac.ir
```



Figure S3. Mass spectrum of compound 1.



Figure S4. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 2.



Figure S5. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 2.



Figure S6. Mass spectrum of compound 2.



Figure S7. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 3.



Figure S8. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 3.



Figure S9. Mass spectrum of compound 3.



Figure S10. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 4.



Figure S11. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 4.



Figure S12. Mass spectrum of compound 4.



Figure S13. <sup>1</sup>H NMR spectrum (250 MHz,  $CDCl_3$ ) of compound 5.



Figure S14. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 5.



Figure S15. Mass spectrum of compound 5.



Figure S16. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 6.



Figure S17. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 6.



Figure S18. Mass spectrum of compound 6.



Figure S19. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 7.



Figure S20. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 7.



Figure S21. Mass spectrum of compound 7.



Figure S22. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 8.



Figure S23. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 8.



Figure S24. Mass spectrum of compound 8.



Figure S25. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 9.



Figure S26. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 9.



Figure S27. Mass spectrum of compound 9.



Figure S28. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 10.



Figure S29. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 10.



Figure S30. Mass spectrum of compound 10.



Figure S31. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 11.



Figure S32. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 11.



Figure S33. Mass spectrum of compound 11.



Figure S34. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 12.



Figure S35. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 12.



Figure S36. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 13.



Figure S37. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 13.



Figure S38. Mass spectrum of compound 13.



Figure S39. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 14.



Figure S40. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 14.



Figure S41. Mass spectrum of compound 14.



Figure S42. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 15.



Figure S43. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 15.



Figure S44. Mass spectrum of compound 15.



Figure S45.  $^{1}$ H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 16.



Figure S46. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 16.



Figure S47. Mass spectrum of compound 16.



Figure S48. <sup>1</sup>H NMR spectrum (250 MHz, CDCl<sub>3</sub>) of compound 17.



Figure S49. <sup>13</sup>C NMR spectrum (62.5 MHz, CDCl<sub>3</sub>) of compound 17.



Figure S50. X-Ray diffraction (XRD) pattern of Cu/C.



Figure S51. Scanning electron microscopy (SEM) image of Cu/C.