Electronic Supplementary Material (ESI) for Green Chemistry.

Electronic Supporting Information

Electrohydrodimerization of biomass-derived furfural generates a jet fuel precursor

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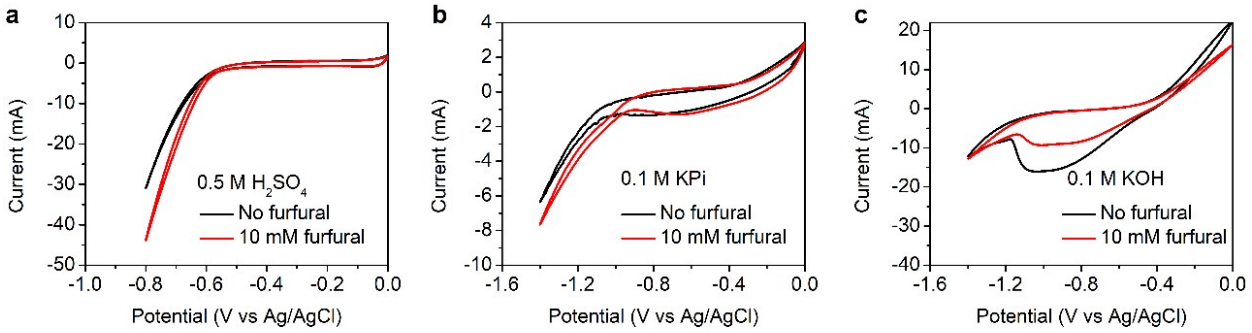
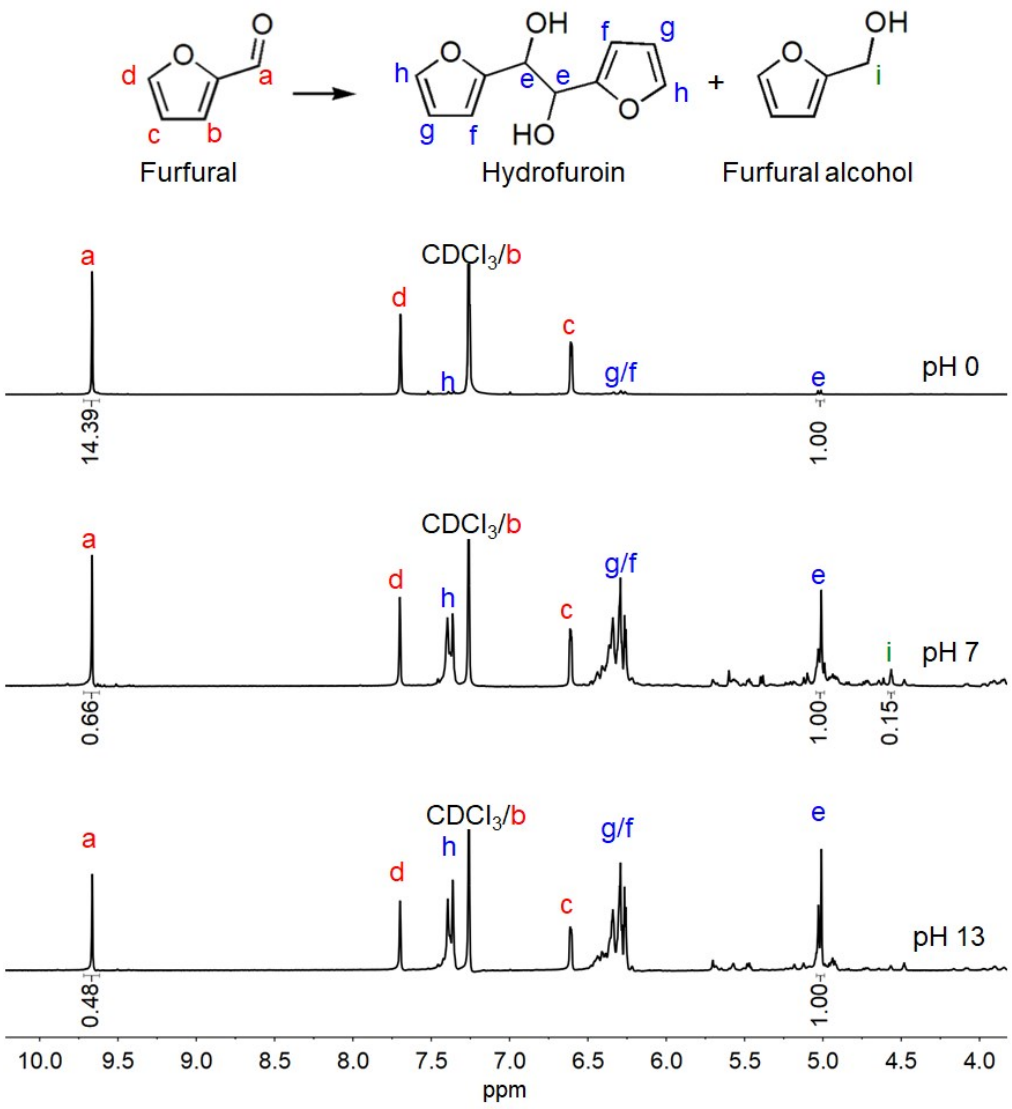
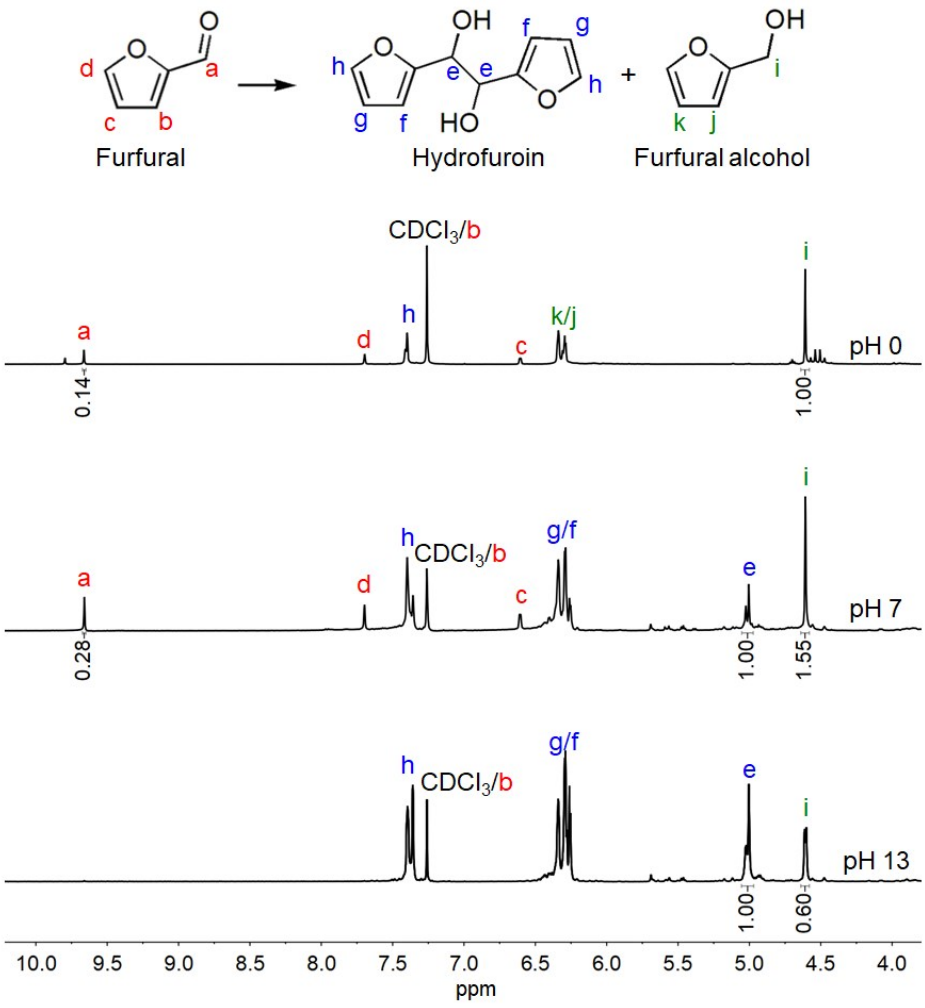


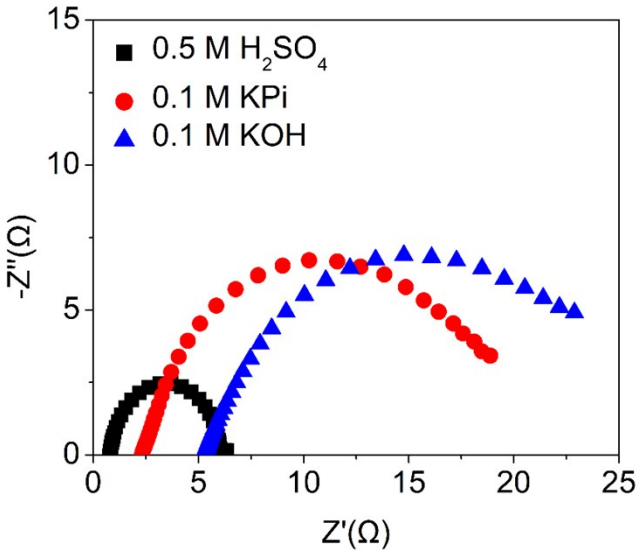
Supplementary Fig. 1. CV curves of 10 mM furfural on Cu foam electrode in (a) 0.5 M H_2SO_4 (pH 0), (b) 0.1 M KPi (pH 7), and (c) 0.1 M KOH (pH 13). Scan rate: 50 mV s^{-1}.



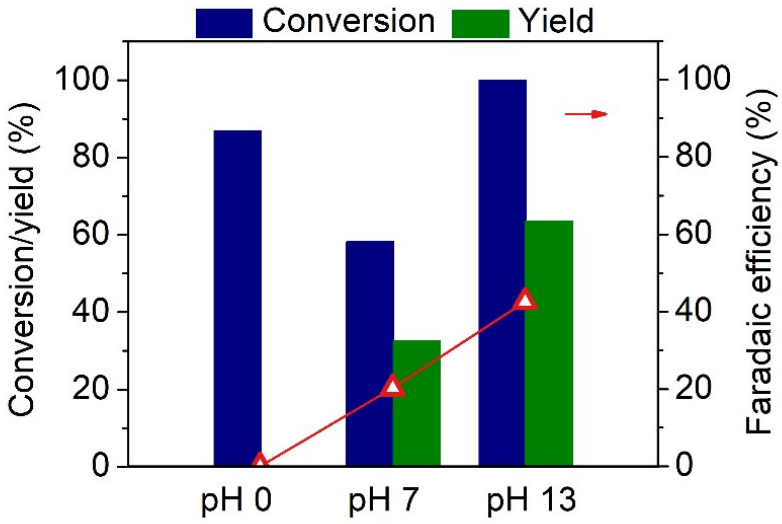
Supplementary Fig. 2. ^{1}H NMR spectra of products after electroreduction of 10 mM furfural on carbon paper with passed charge of 10 C. Conditions: constant potential of -0.9 V for pH 0, -1.3 V for pH 7, and -1.4 V for pH 13, vs Ag/AgCl.



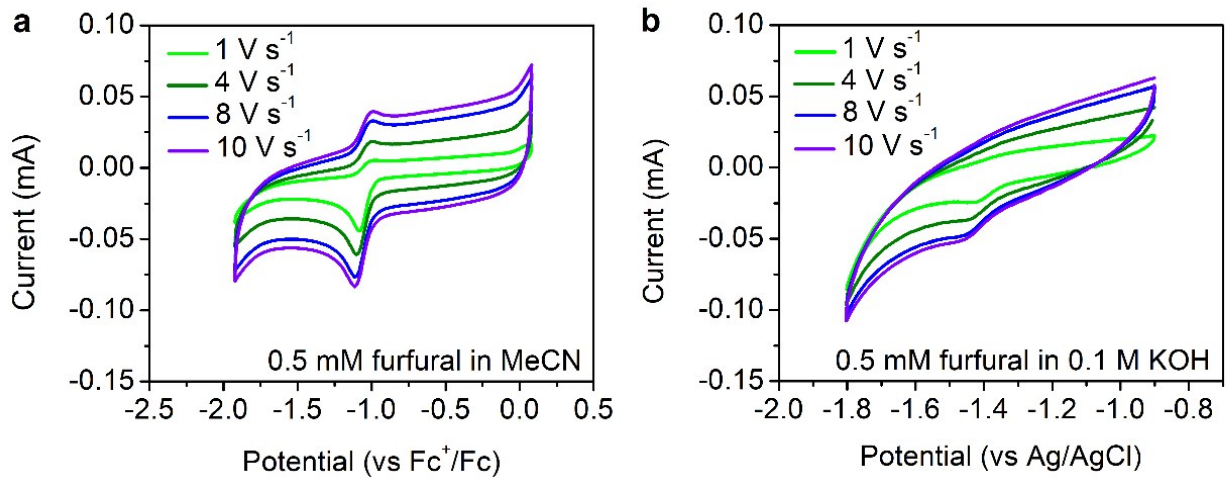
Supplementary Fig. 3. ^{1}H NMR spectra of products after electroreduction of 10 mM furfural on Cu foam for 2 h. Conditions: constant potential of -0.7 V for pH 0, -1.3 V for pH 7, and -1.4 V for pH 13, vs Ag/AgCl.



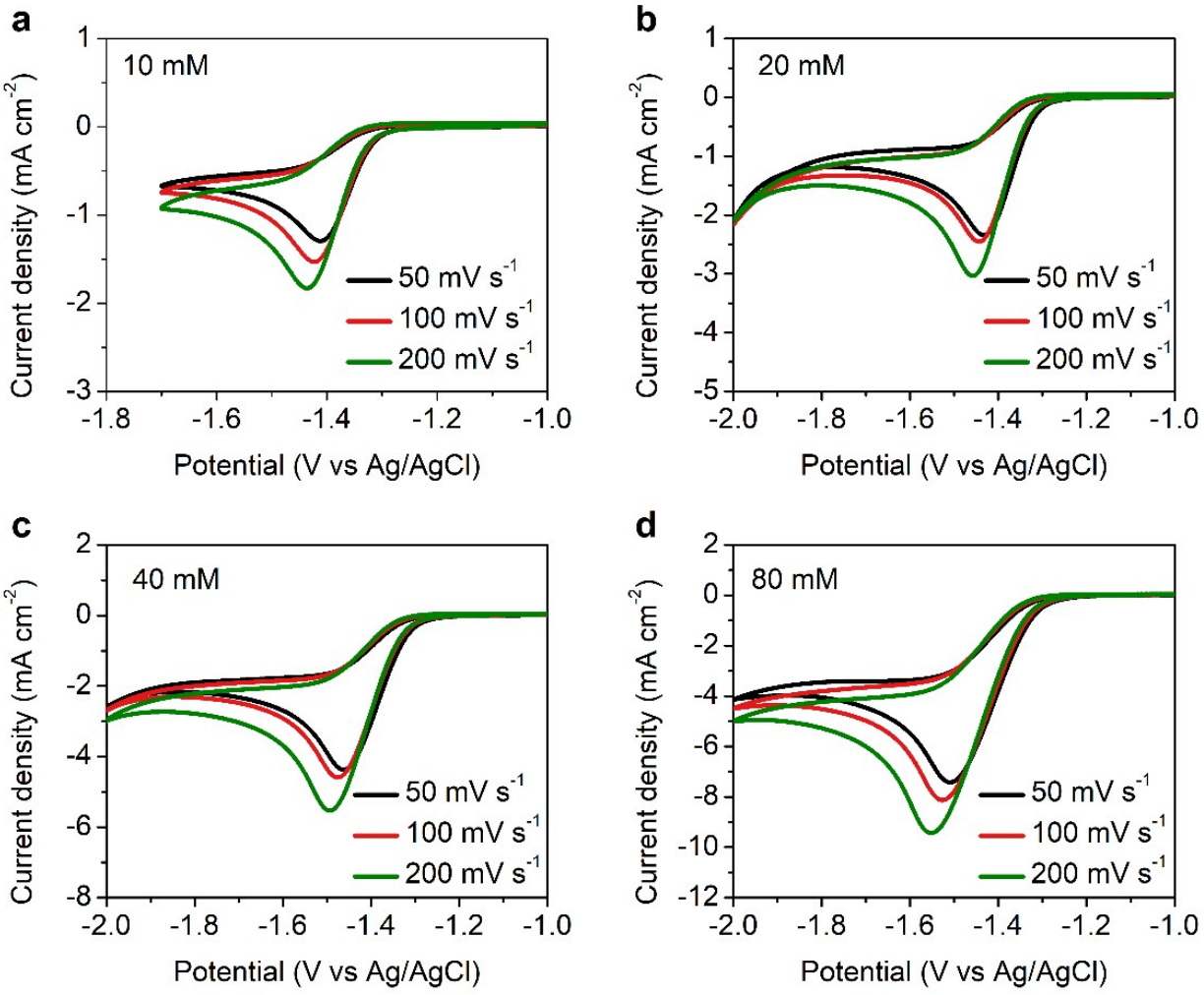
Supplementary Fig. 4. Nyquist plots of electrolytes containing 10 mM furfural at -0.9, -1.4 and 1.4 V (vs Ag/AgCl) in 0.5 M H_2SO_4, 0.1 M KPi and 0.1 M KOH, respectively. Electrode: carbon paper.



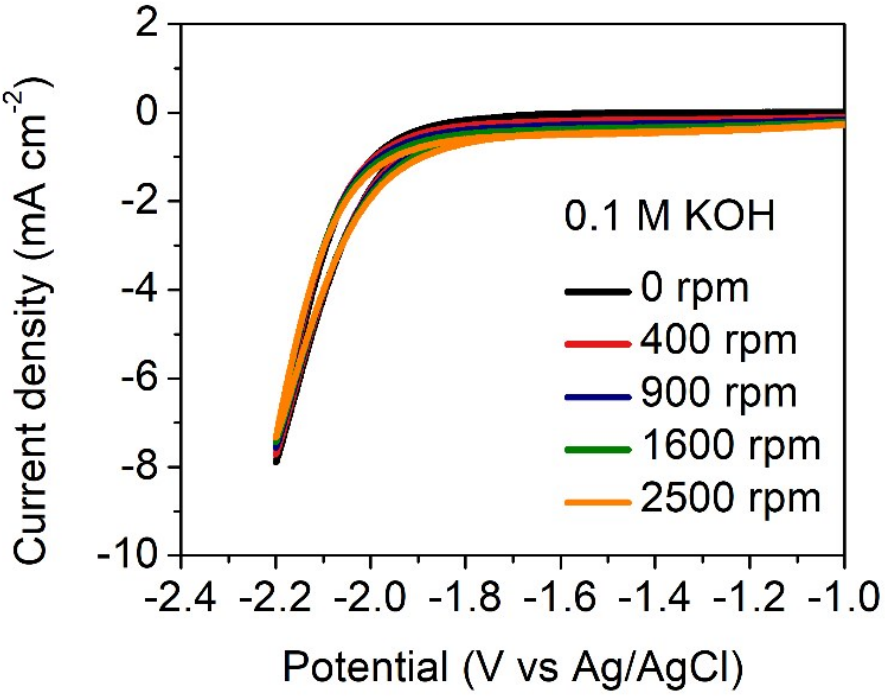
Supplementary Fig. 5. Conversion efficiency of furfural and the yield/Faradaic efficiency of hydrofuroin product on Cu foam for 2 h in electrolytes of different pHs. The theoretical charge of full conversion of furfural requires ~14 C. The actual passed charge during electrolysis was 319.1, 31.5, 28.8 C for pH 0, 7, and 13, respectively.



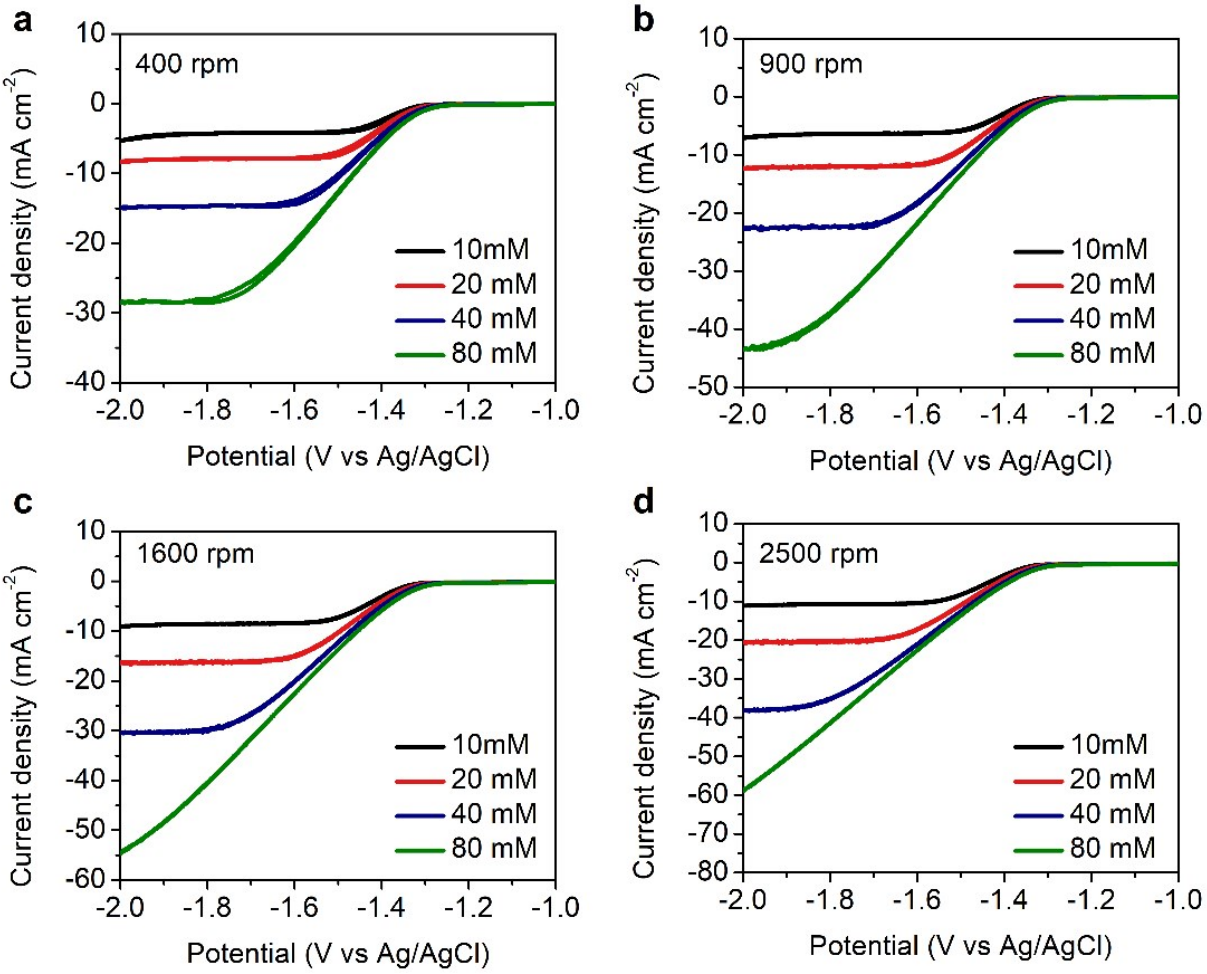
Supplementary Fig. 6. Fast scan CVs of furfural electroreduction in (a) acetonitrile (0.1 M of tetrabutylammonium tetrafluoroborate supporting electrolyte) calibrated by ferrocene (Fc^+/Fc) and (b) 0.1 M KOH.



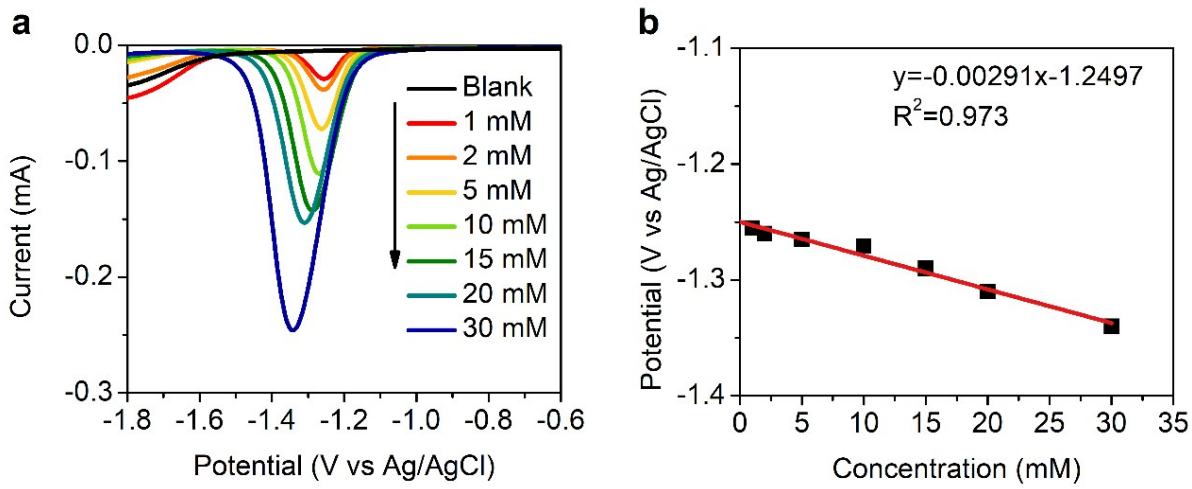
Supplementary Fig. 7. CVs of furfural electroreduction varied by concentration: (a) 10 mM, (b) 20 mM, (c) 40 mM, and (d) 80 mM.



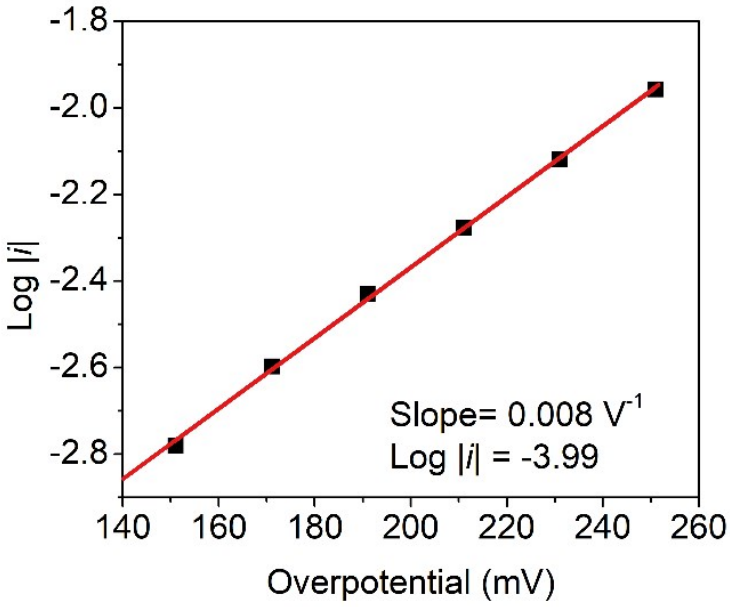
Supplementary Fig. 8. CV plots of 0.1 M KOH on RDE varied by rotating rate.



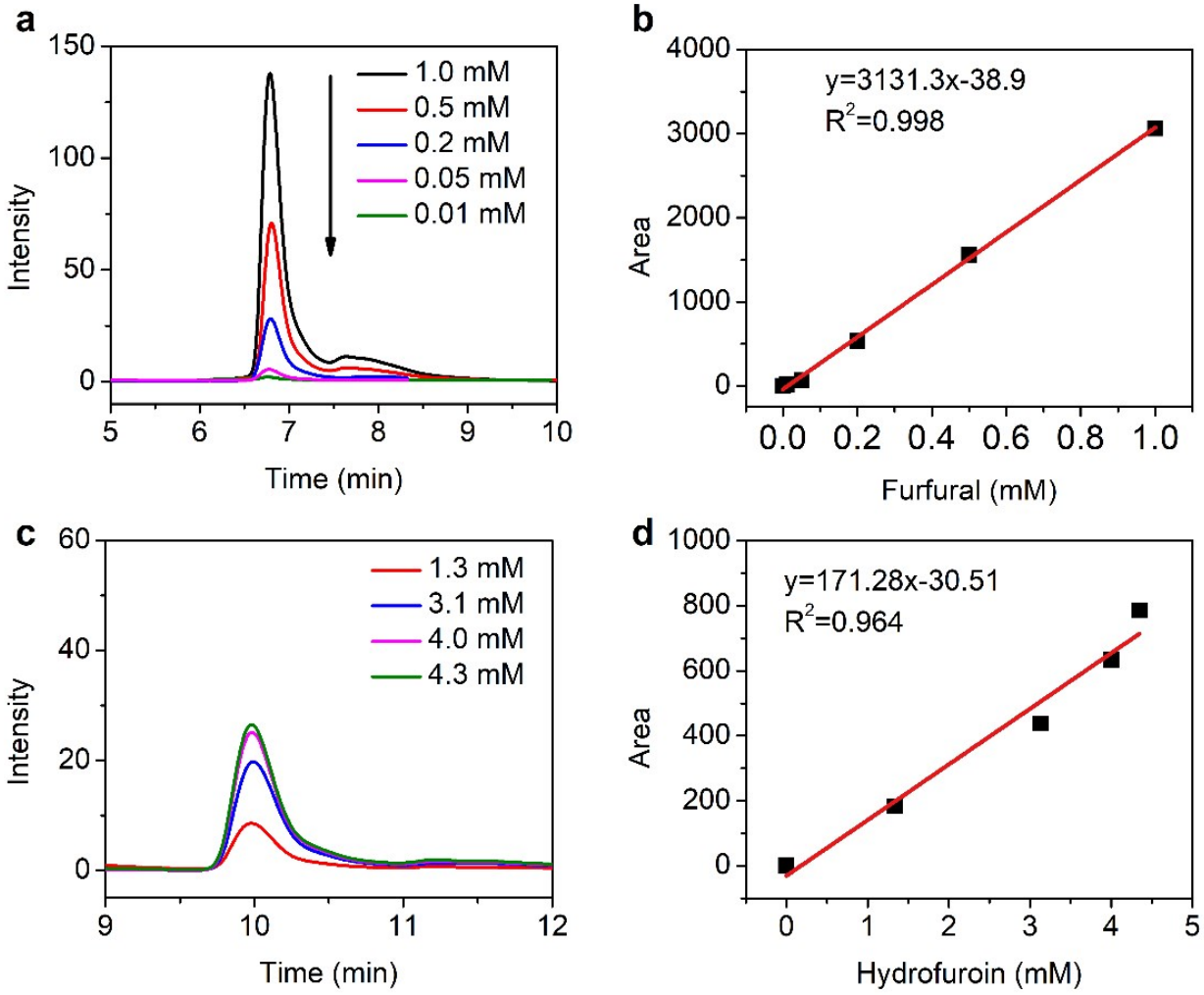
Supplementary Fig. 9. CV plots of electroreduction of furfural (10, 20, 40 and 80 mM in 0.1 M KOH) varied by rotating rate: (a) 400 rpm, (b) 900 rpm, (c) 1600 rpm, and (d) 2500 rpm.



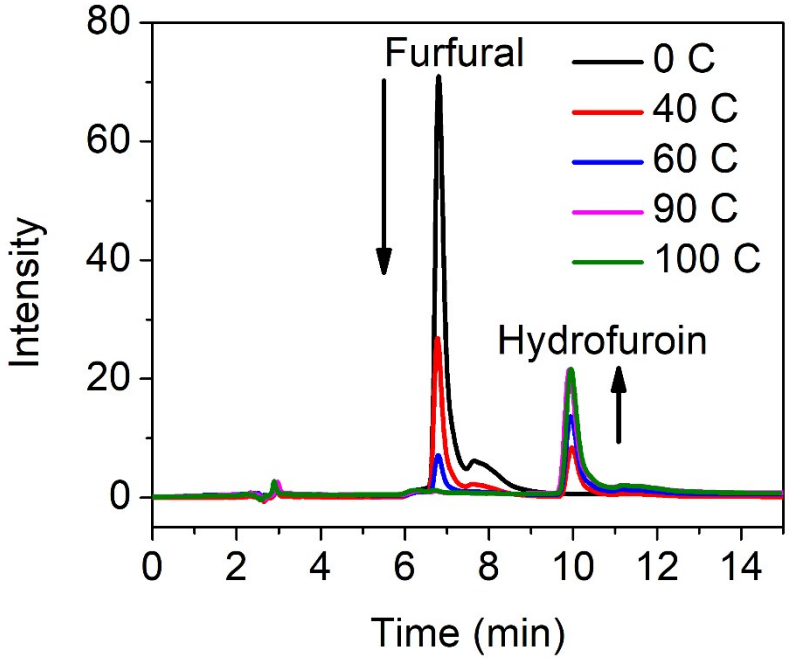
Supplementary Fig. 10. Determination of the thermodynamic potential of furfural electroreduction in 0.1 M KOH. (a) Square wave voltammograms of furfural in 0.1 M KOH with different concentrations. Conditions: increase E = 5 mV, amplitude = 25 mV, frequency = 10 Hz. (b) Simulated linear plot of potential versus concentration of furfural. Herein the thermodynamic potential of furfural reduction in 0.1 M KOH was determined to be -1.25 V vs Ag/AgCl.



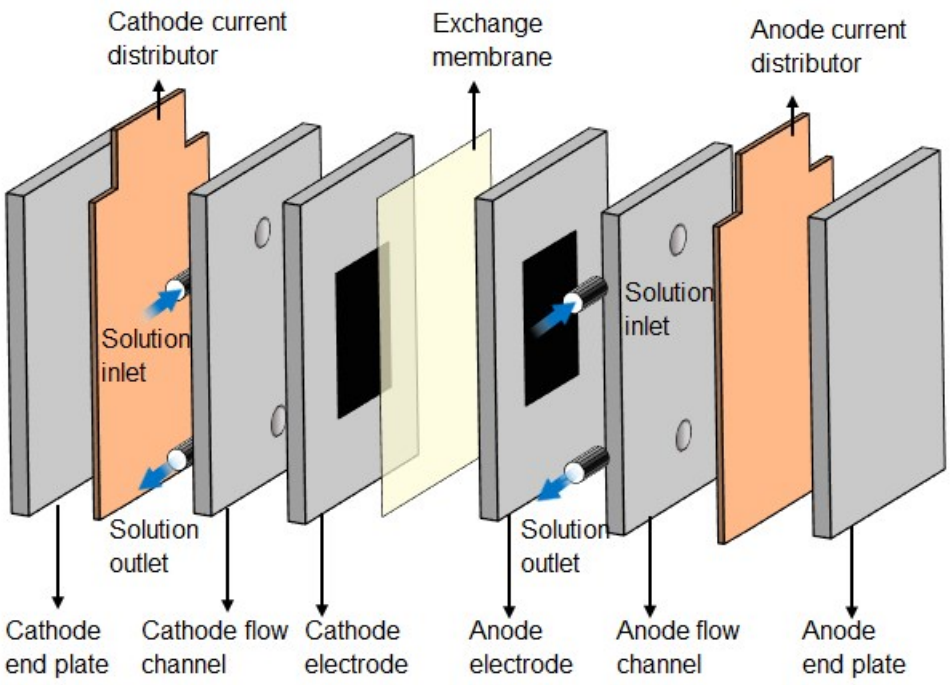
Supplementary Fig. 11. Fit of Butler-Volmer equation derived from Figure 2b, which yielded an electron-transfer rate constant (k^0) of 0.05 cm s^{-1}.



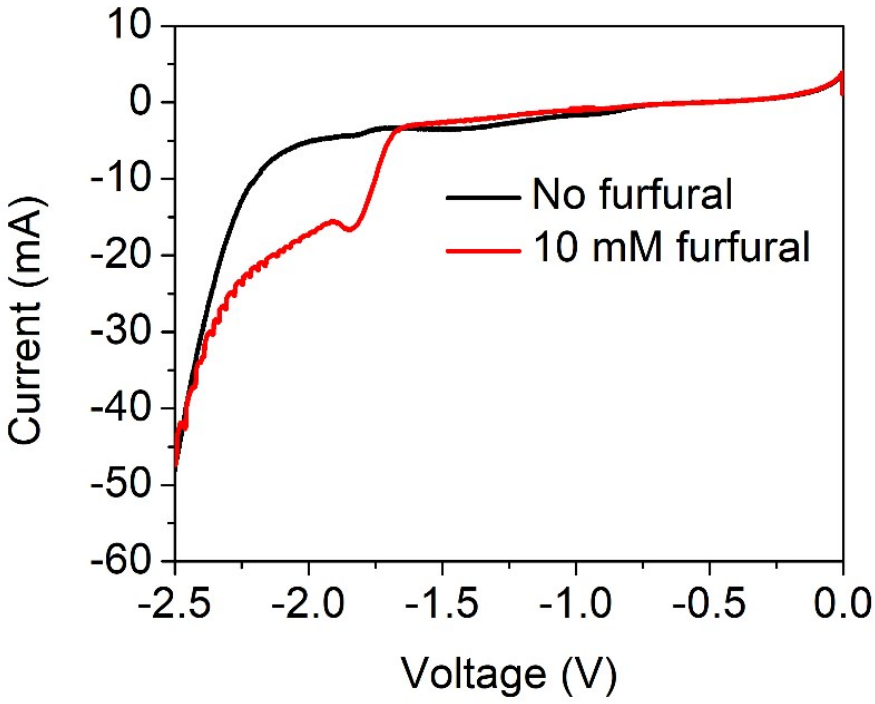
Supplementary Fig. 12. HPLC traces of (a) furfural and (c) hydrofuroin. Related standard curves of (b) furfural and (d) hydrofuroin.



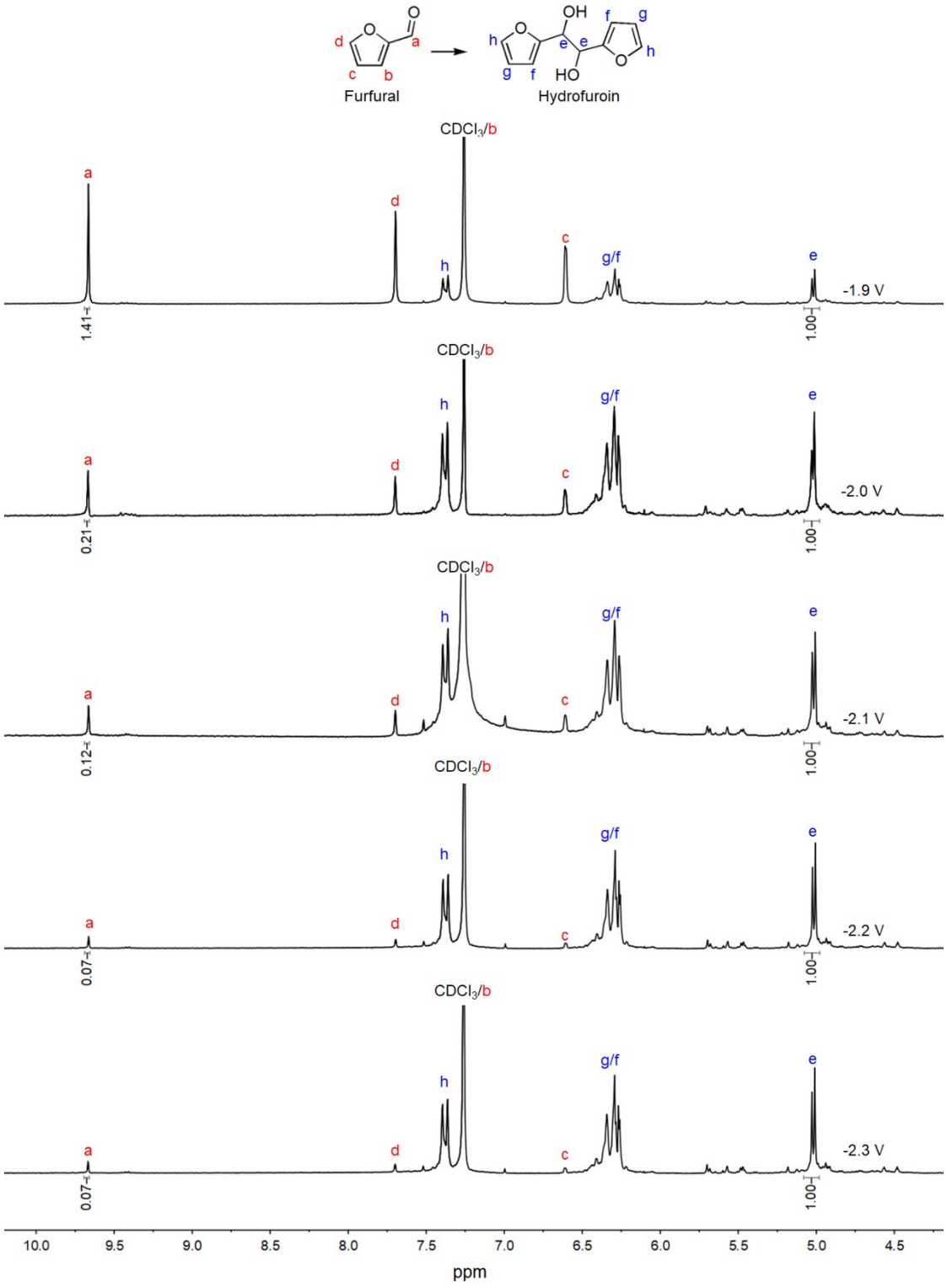
Supplementary Fig. 13. HPLC trace evolution of electroreduction of 100 mM furfural electrolysis on carbon paper at -1.4 V vs Ag/AgCl in 10 mL of 0.1 M KOH.



Supplementary Fig. 14. Schematic of flow electrolyzer.



Supplementary Fig. 15. LSV curves of furfural electroreduction in a flow electrolyzer. Scan rate = 10 mV s^{-1} and flow rate = 0.5 mL min^{-1}.



Supplementary Fig. 16. ^{1}H NMR spectra of products from furfural electrolysis in a flow electrolyzer at different applied voltages.