Supporting Information

Electrolessly deposited carbon-supported CuNiSn electrocatalysts for the electrochemical reduction of CO_2

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SEM images with a magnification x 1000

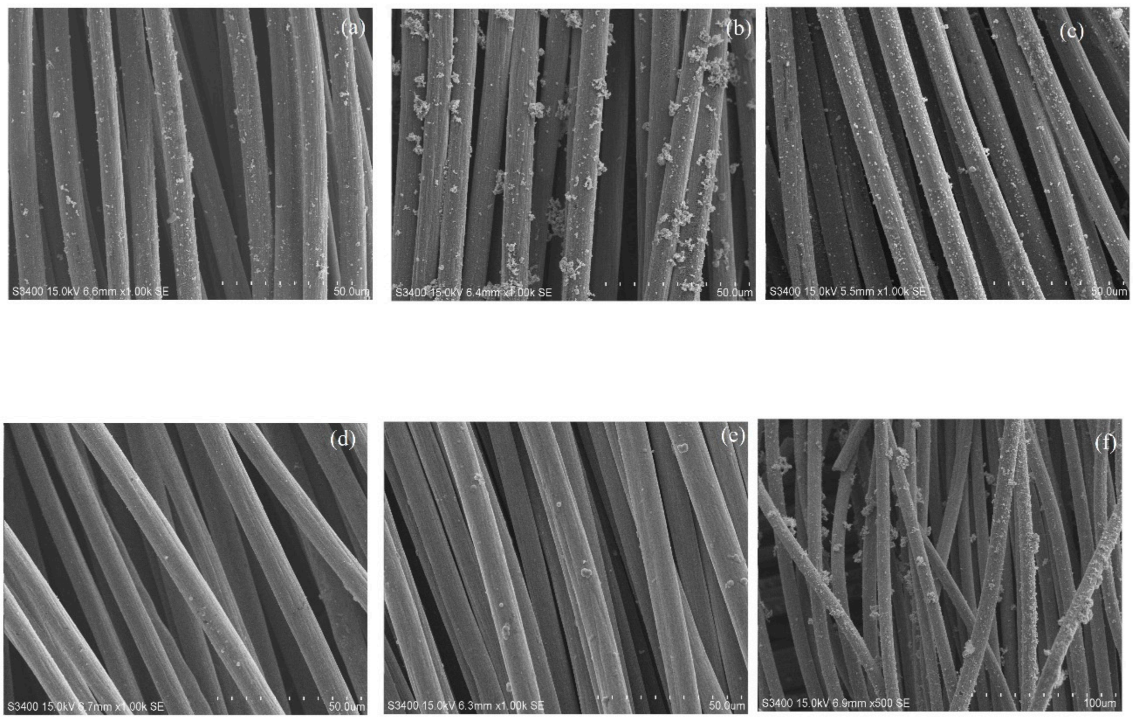

Figure S1. SEM images of (a) CuNiSn/CS, (b) CuSn/CS, (c) CuNi/CS, (d) NiSn/CS, (e) Ni/CS and (f) Cu/CS

[1]H-NMR spectra of the electrolyte

[1]H-NMR spectra of the electrolyte under a constant potential of −1.6 V vs. Ag/AgCl for 150 min over studied electrocatalysts showed that they were composed of formate, 1-butanol, ethylene glycol, acetone, and ethanol, and DMSO (internal standard). The purple, blue, red, pink, orange, and green circles represent the peaks of formate, 1-butanol, ethylene glycol, ethanol, acetone, and acetate, respectively. However, a trace amount of 1-butanol was observed.

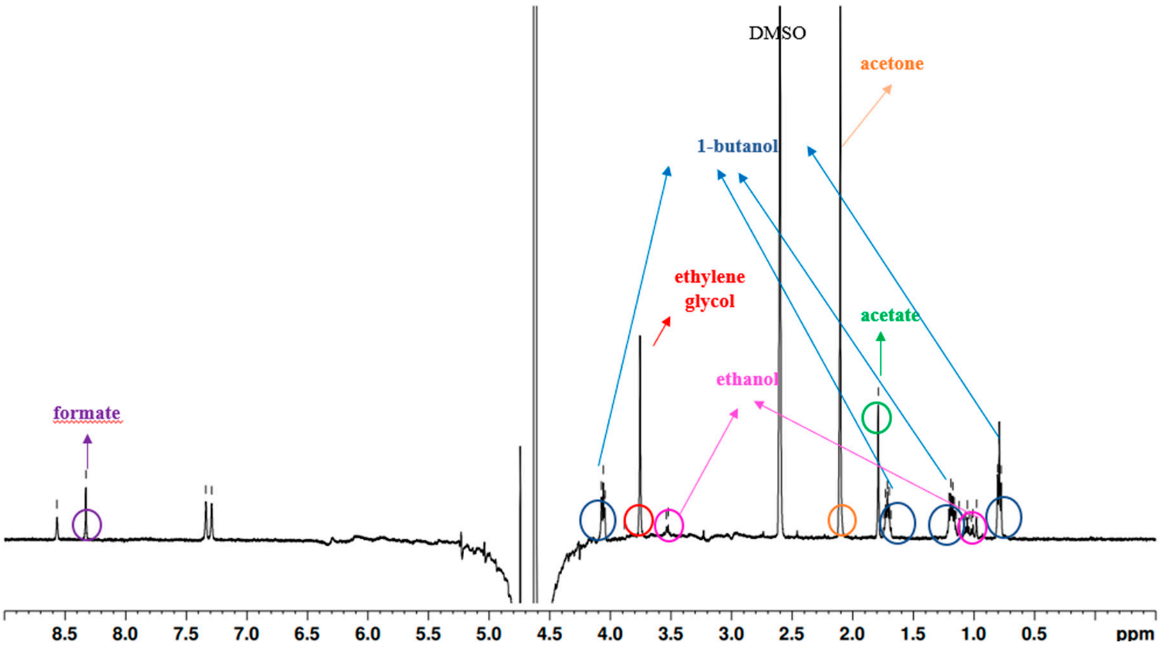

Figure S2. [1]H NMR spectrum over CuNiSn/CS

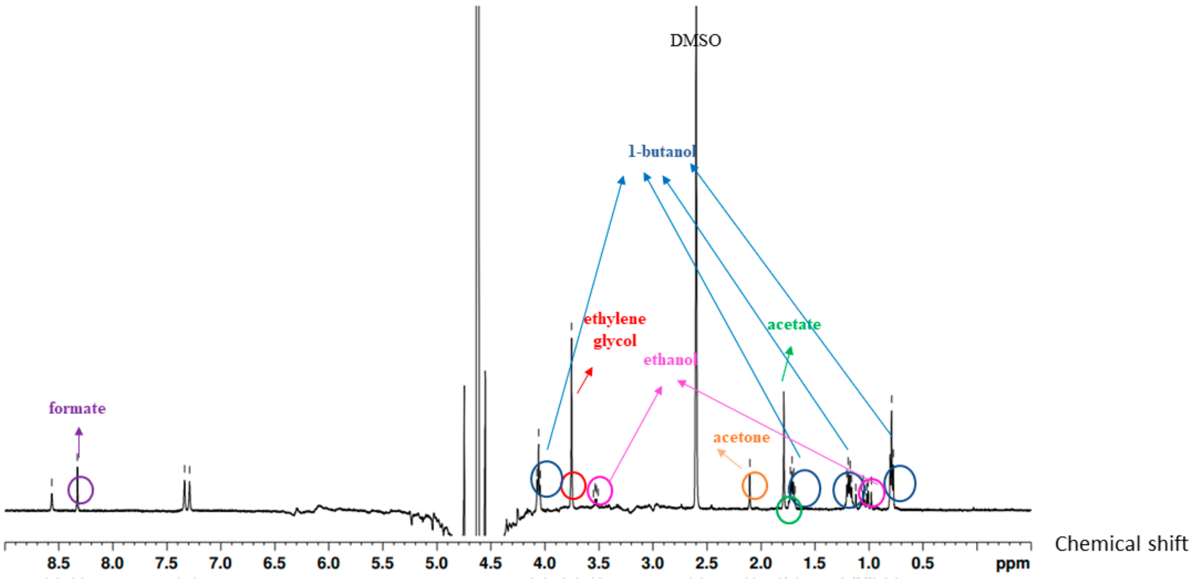

Figure S3. ^{1}H NMR spectrum over CuNi/CS

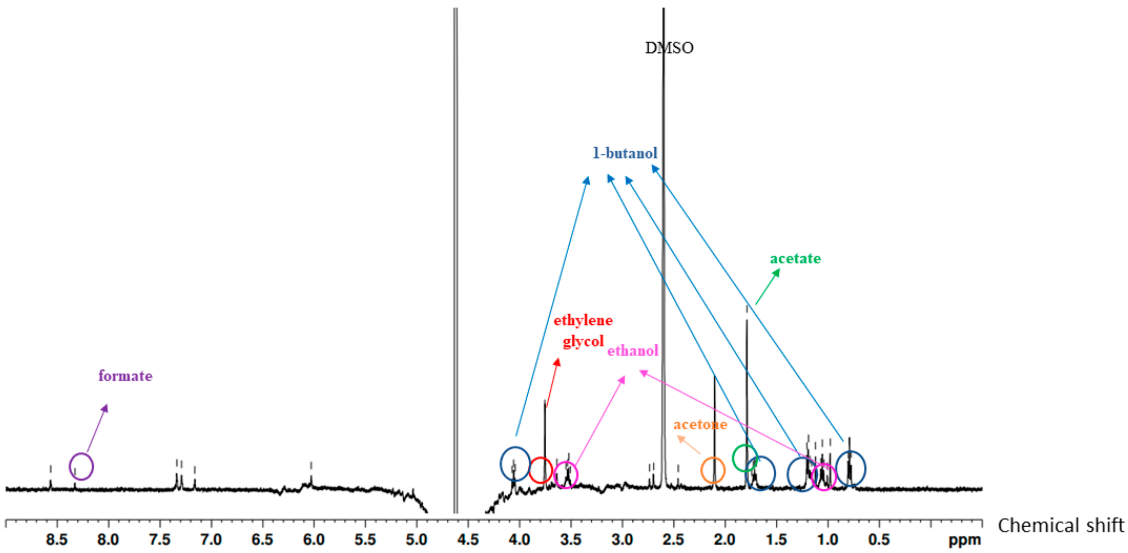

Figure S4. ^{1}H NMR spectrum over NiSn/CS

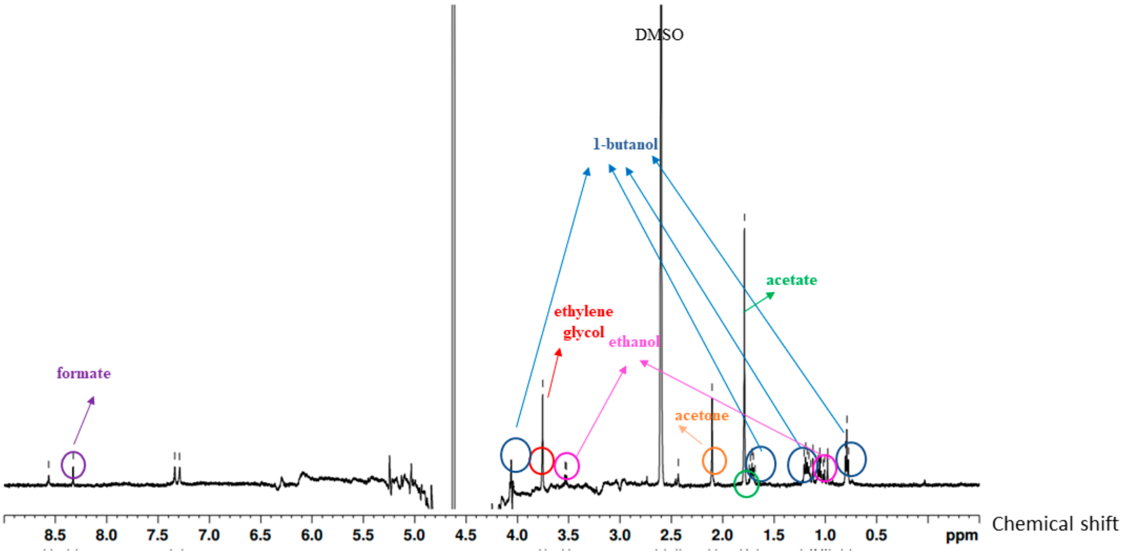

Figure S5. ^{1}H NMR spectrum over Ni/CS

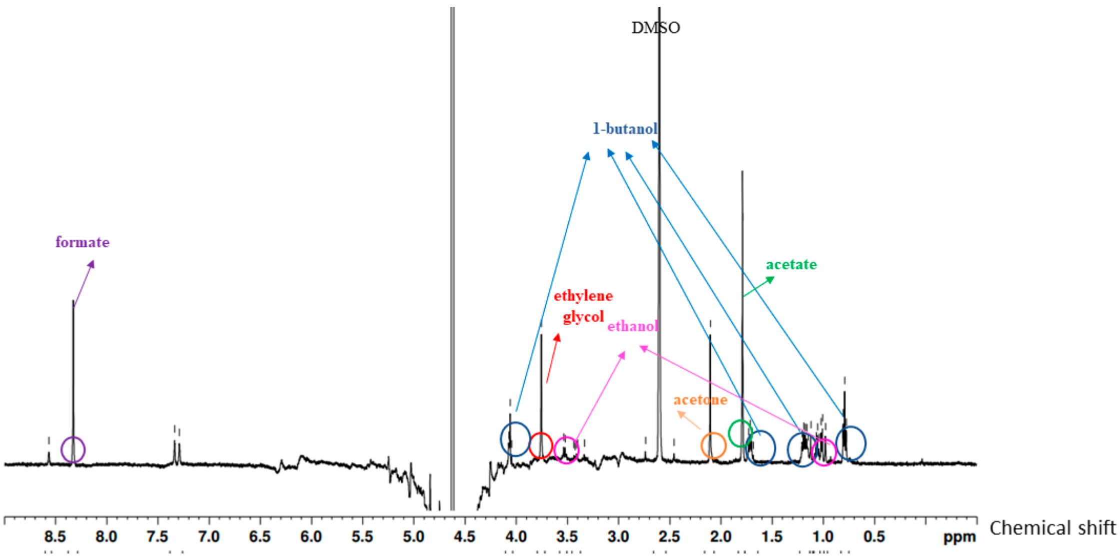

Figure S6. ^{1}H NMR spectrum over Cu/CS

A gas chromatography

A gas chromatography (GC) system with a thermal conductivity detector (TCD) was used to detect H_2 and CO and the operating condition of GC was shown in Table S.1. Numbers on chromatogram are retention times of H_2, O_2, N_2, CO, and CO_2.

Table S1.The operating conditions of gas chromatograph with a thermal conductivity detector

Gas chromatography (Shimadzu GC-2014)	Conditions
Detector	TCD
Column information	Shincarbon ST(50/80)
Carrier gas	Helium (99.999%)
Injector temperature	180°C
Column initial temperature	40°C, Hold time 5 min
Column temperature rate	10°C/min
Column final temperature	200°C
Detector temperature	170°C
Total time analysis	21 min

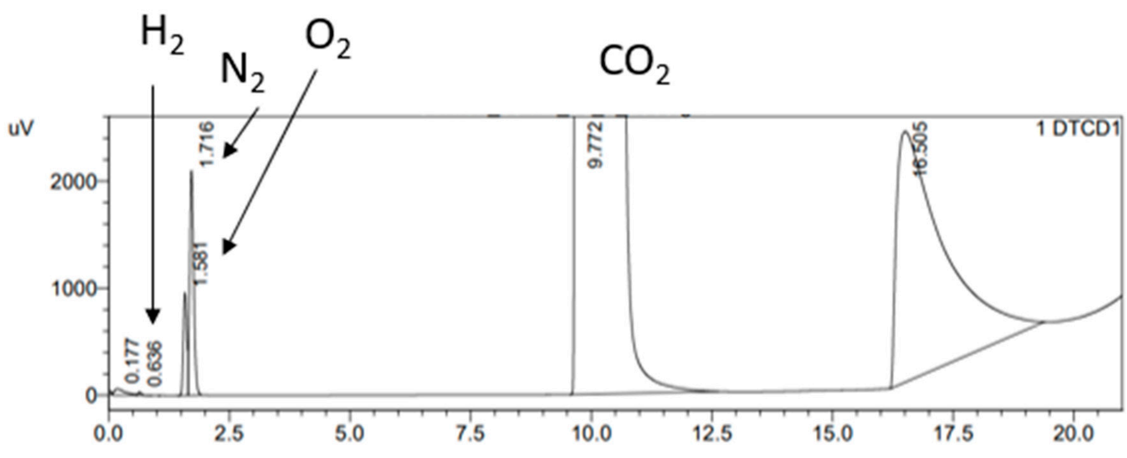

Figure S7. Chromatogram generated by a GC of CuNiSn/CS

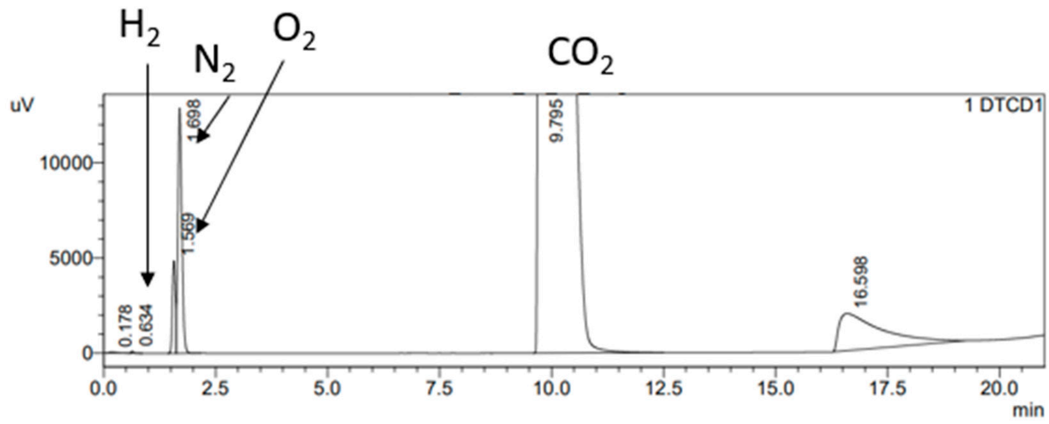

Figure S8. Chromatogram generated by a GC of CuNi/CS

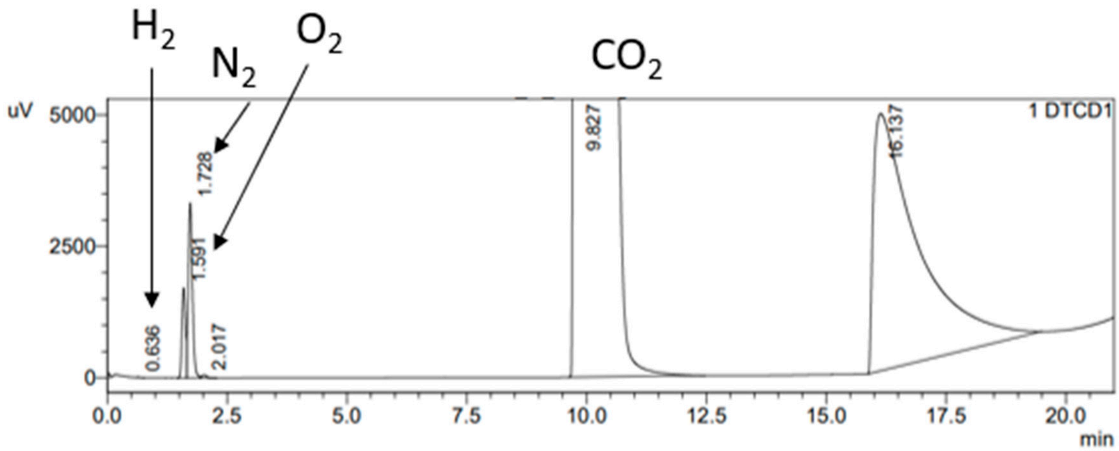

Figure S9. Chromatogram generated by a GC of NiSn/CS_30

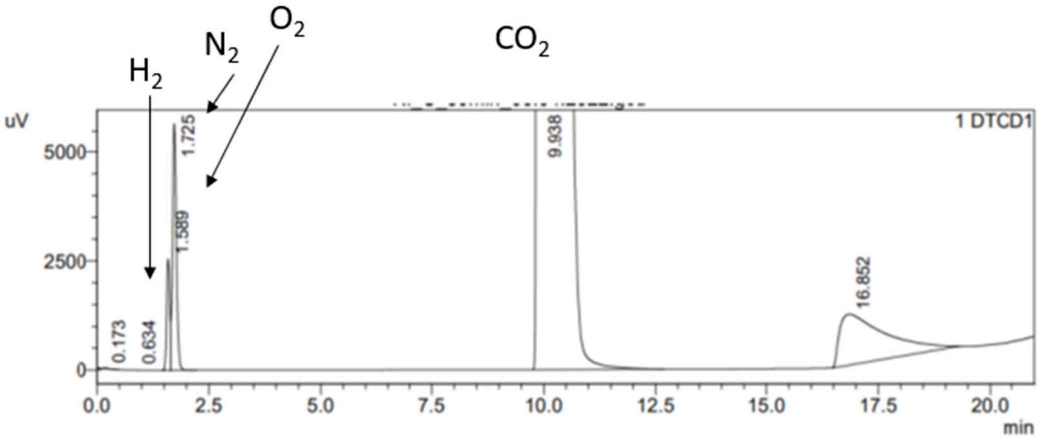

Figure S10. Chromatogram generated by a GC of Ni/CS_30

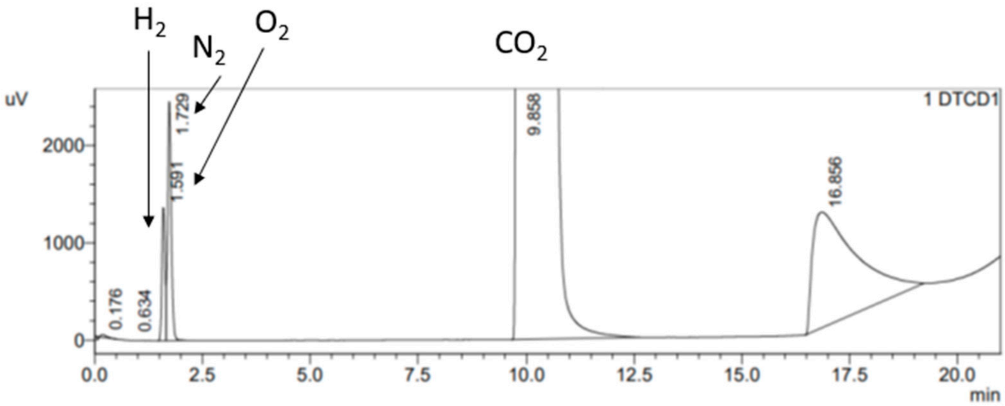

Figure S11. Chromatogram generated by a GC of Cu/CS_30