Electronic Supplementary Information

for

The effect of electrolyte composition on the electroreduction of CO$_2$ to CO on Ag based gas diffusion electrodes

Sumit Verma,[ab] Xun Lu,[a] Sichao Ma,[bc] Richard I. Masel[d] and Paul J. A. Kenis[*ab]

[a.] *Department of Chemical & Biomolecular Engineering, University of Illinois at Urbana Champaign, 600 South Mathews Avenue, Urbana, Illinois 61801, USA.*

[b.] *International Institute for Carbon Neutral Energy Research (WPI-I2CNER), Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.*

[c.] *Department of Chemistry, University of Illinois at Urbana-Champaign, 505 South Mathews Avenue, Urbana, IL 61801, USA.*

[d.] *Dioxide Materials, 3998 FAU Boulevard #300, Boca Raton, Florida 33431, USA.*

* Author to whom correspondence should be addressed. Email: kenis@illinois.edu

Contents

I. pH measurements before and after the electroreduction of CO_2 to CO for different electrolytes at a cell potential of -2.25 V and -2.75 V.

Table S1 Total current density (j_{total}), cathode potential, initial, and final pH for different electrolytes at cell potentials of -2.25 V and -2.75 V.

Electrolyte	Initial pH	Cell Potential = -2.25 V			Cell Potential = -2.75 V		
		Cathode Potential (*vs.* RHE)	j_{total} (mA cm^{-2})	Final pH	Cathode Potential (*vs.* RHE)	j_{total} (mA cm^{-2})	Final pH
2.0 M KCl	6.54	-0.60	1.7	6.66	-0.99	51.4	10.21
2.0 M KHCO₃	8.59	-0.60	7.3	8.60	-0.87	55.5	8.81
2.0 M KOH	13.77	-0.66	105.4	13.72	-0.98	269.3	13.61
1.5 M KCl + 0.5 M (1:2) Choline Cl Urea	6.52	-0.55	0.9	6.64	-0.87	22.1	10.02

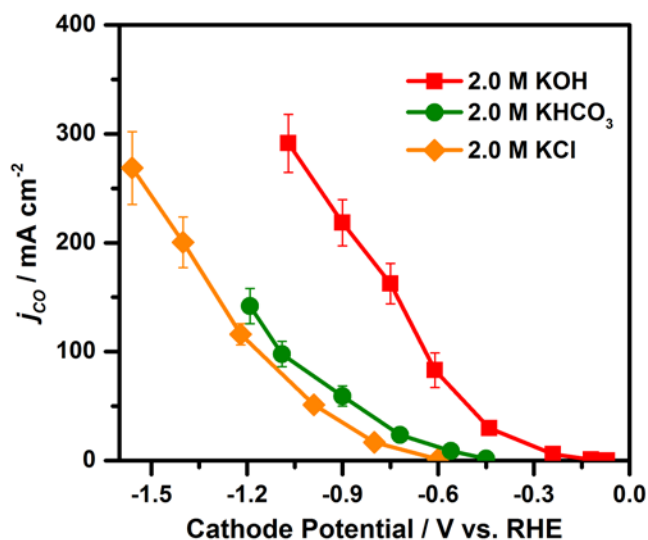## II. Effect of Nafion on the electroreduction of CO_2 to CO on Ag based gas diffusion electrodes.

Fig. S1 Partial current density for CO using different electrolytes when using Ag nanoparticles without Nafion as the cathode catalyst and IrO_2 as the anode catalyst.

II. Electrochemical performance for mixtures of 2.5 M KCl with 0.5 M EMIM Cl, and 0.5 M 1:2 Choline Cl urea deep eutectic solvents (DES).
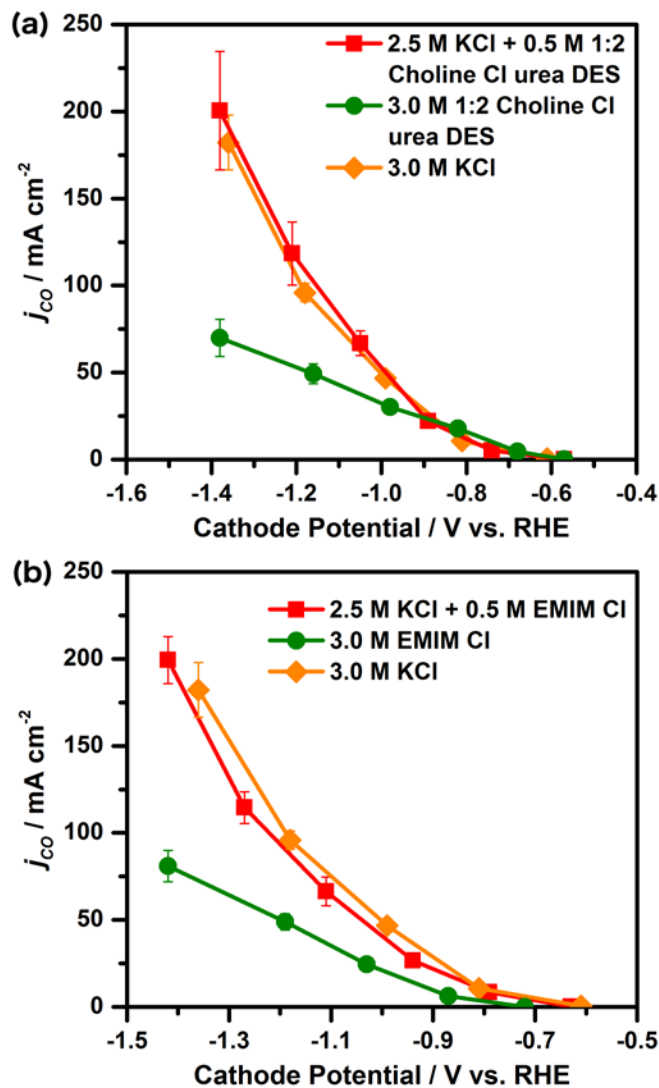

Fig. S2 Partial current density for CO using different electrolytes, specifically combinations of KCl with (a) 1:2 Choline Cl urea DES and with (b) EMIM Cl when using Ag nanoparticles as the cathode catalyst and IrO_2 as the anode catalyst.