Electrochemical CO_2 Reduction

5% of total								
Question	2.1	2.2	2.3	2.4	2.5	2.6	2.7	**Total**
Points	2	8	3	3	5	8	4	**33**
Score								

2.1 (2 pt)
Write and balance the chemical equation of the half-cell reactions for the following electrochemical reduction processes in acidic environment (i) CO_2 to ethanol; (ii) CO_2 to *n*-propanol.

(i)

(ii)

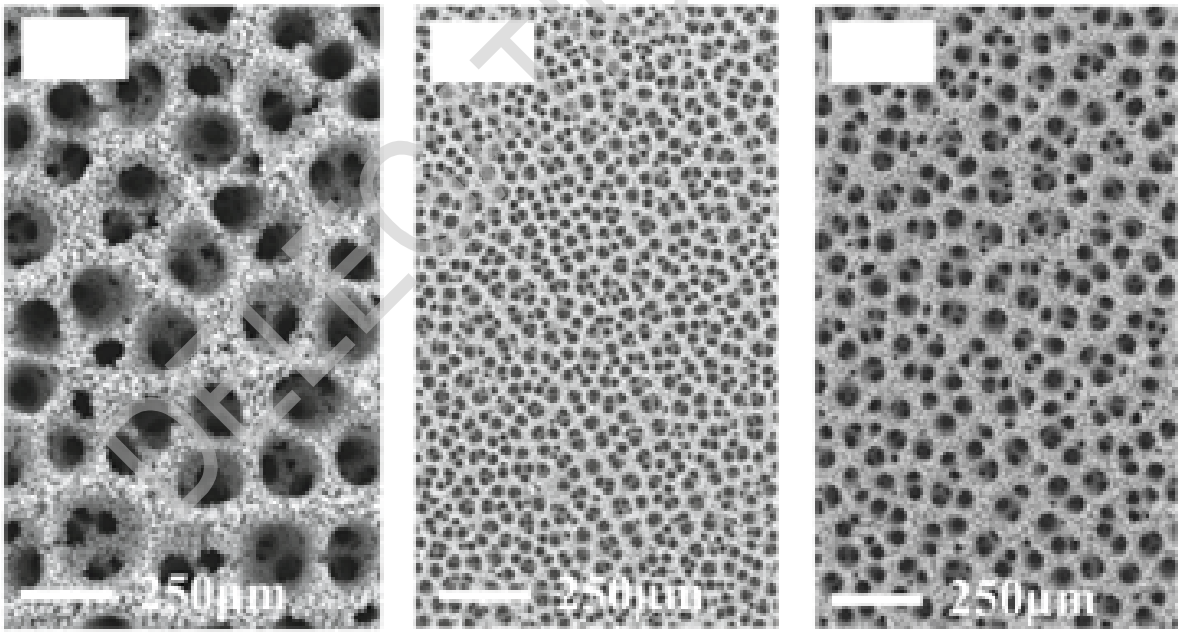
2.2 (8 pt)
Combine the half-cell of the reduction process with an $H_2/2H^+$ half-cell where the latter acts as anode. **Calculate** the value of the standard cell potential of the CO_2 to **ethanol** reduction.

$E_{(CO_2 \text{ to ethanol})}$ _____ V

2.3 (3 pt)
Write all the reduction and oxidation half-cell reactions taking place at the cathode and the anode, respectively.
Anode reaction(s):

Cathode reaction(s):

2.4 (3 pt)
Considering this mechanism, **assign** the correct deposition time to the Cu foams shown in **Figure 2** below **(white boxes upper left corner)**.



2.5 (5 pt)

Calculate the Faradaic efficiency (FE in %) of this metal deposition process. FE is defined as $Q_{\text{product}}/Q_{\text{total}} \cdot 100\%$. Q denotes the charge.

$FE =$ _____ %

2.6 (8 pt)

Calculate the current densities required for the formation of (a) ethanol ($MW_{\text{ethanol}} = 46.08\ \text{g mol}^{-1}$) and (b) *n*-propanol ($MW_{n\text{-propanol}} = 60.10\ \text{g mol}^{-1}$) assuming that the current densities do not change with electrolysis time.

(a) $j(\text{ethanol}) =$ _____ A cm^{-2}

(b) $j(n\text{-propanol}) =$ _____ A cm^{-2}

2.7 (4 pt)

Calculate the volume of the formed hydrogen on the 1 cm^2 catalyst area at 298.15 K and 1 bar, assuming ideal behavior of the formed hydrogen, and its complete release into the gas phase.

*If you did not get a result in **Task 2.5**, continue with* $FE_{(EtOH)} = 45.1\%$ *and* $FE_{(PrOH)} = 4.8\%$.

$V_{H_2} =$ _____ cm^3