BOOK 7
Talal

24-11-2021

→ Stahl Research group : Organic electrochemistry virtual course :
↳ for finding "travel grants to early career researches by nature"
↳ PhD from UoNottingham Toby Walton Clarke · example

→ COURSE: focus on peer Review

Qualifier presentation

→ Introduction
⊙ E-Bio project
⊙ Roles & projects in Ebio
⊙ Products formation and conditions

→ Kolbe electrolysis.
→ challenges
• trends
• recent devolpment

Project 1: Proving & finding why BDD is not suitable for Kolbe product with different faults and to make it more

Project 2

Project 3: Role of electrolyzer design · flow conditions, single pass, multi pass

Project 4: Materials / electrode other than Pt & PGM

Project 5: Surface phenomena

Project 6: Sono electrochemistry · ultrasound organic electrosynthesis

SPO: aqueous phase pyrolysis oil

made by hydrogenation of pyrolysis oil to remove carbonyl content of bio oil.
It means pyrolysis oil is stable but still contain large content of organic acid.

Σ Bio - UT

deliverable Report on optimal electrode material and operation window for Kolbe.
Work package: 2
Due date: M15, 30

MS 21 Decision whether acid separation prior to kolbe is required

TEAM: together everyone achieves more
↳ team work needs maintenance

$2\,CH_3COONa + 2H_2O \rightarrow CH_3CH_3 + H_2 + NaOH$

2 mole Nac produce 1 mol ethane
1 mol " " $= \frac{1}{2}$ mol ethane
$= 12150$ ml ethane

$PV = nRT$
$n = \left(\frac{PV}{RT}\right)$

$PV = nRT$
$PV = 1(\ )(\ )$
$V = \frac{(1)(\ )(\ )}{(\ )}$

$V = \frac{1}{2}\frac{PV}{RT}$

82.034 g/mol = 12150 ml ethane
1 g/mol $= \frac{12150}{82.034}$ etc
$= 148.104$ ml ethane
$= 148104.3$ ppm ethane

1 ml = 1000 ppm

Task for tomorrow

- email to Bastian
- email to laser cutting
- electrode material
- GC calibration start
- protocol for BDD
- Erna chemical produce
- email Kasper/bastian
- make proposal SECM
- design experiment EC-MS
- Design experiment Cation influence, pH influence, non kolbe
- prepare electrodensity data analysis sheet, FE

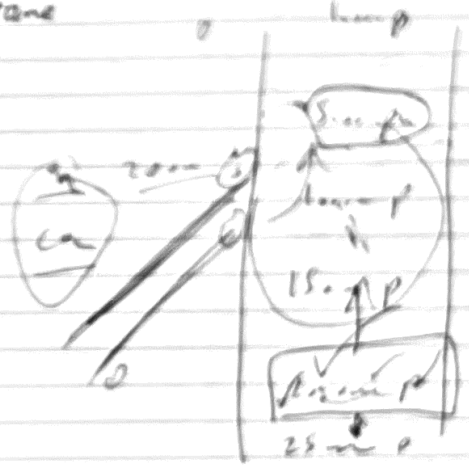
- BDD → doubleside coated electrodes.
  0.1M – 0.5M H_2SO_4
  fouling : ag
  3μm BDD layer : Raman :
  1A/cm² → 3 days : → ele
  500-mA/cm
- 26mm → keep it away : thickness measure across the electrode ; → I A
- Carbon material :
  graphite (pca, Carbonyl → sp3)
  sometime behave like diamond
  2mΩ :
  0.7mm thick backside : wafer.
  ↳ : graphite → doesn't form gasous products.
  ↳ extend :
  wetting (OH⁻)
- fraunhofer : sicogas group kolbe electro on BDD
- every 4 weeks (meeting) →

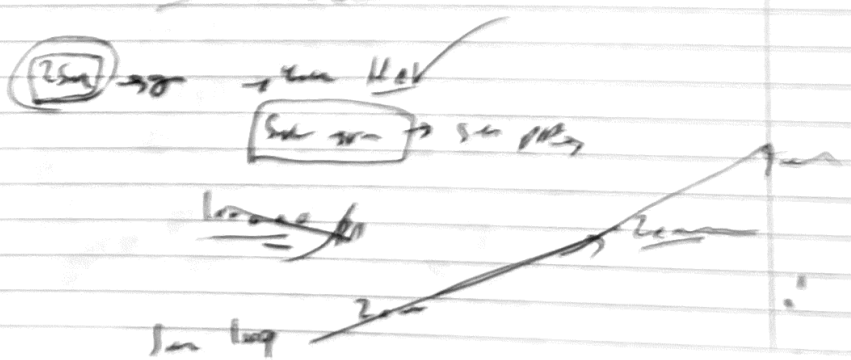
electrode cleaning

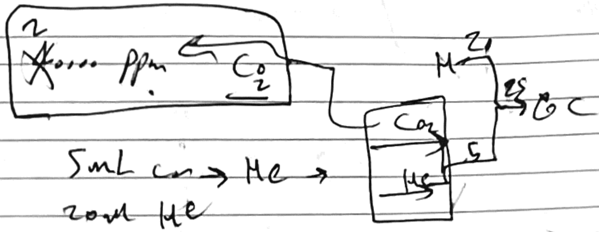
→ alcohol, in beaker, sonicate 10 mins
→ dipped in H_2SO_4 @, 10 mins
→ rinse with water, sonicate with water : 10 mins

limitation :

methane
ethane
ethylene
CO_2
acetone
O_2
H_2







2 ml co →

20000 ppm in 5 ml, 2 ml

2×10^{-2} ml $\times$ 5 ml = g/ml CO_2

Sobhan GC CO_2 calibration

20,000 — 1.81 area, 69

5.65 = 5.7 ml flow.

average, at flow rate

FIC 203, CO_2 } → 55 ml
FIC 12 – He

F110 – He dilution } → 20 ml.

$$pH = pKa + \log_{10}\left[\frac{(\text{Conc salt})}{(\text{Conc Acid})}\right]$$

$$8 = 4.756 + \log\left(\frac{salt}{acid}\right)$$

$$8 - 4.756 = \log\left(\frac{salt}{acid}\right)$$

$$1753.8005 = \frac{salt}{acid}$$

$$\log \frac{salt}{acid} = pH - pKa$$

$$\frac{salt}{acid} = 10^{(pH-pKa)}$$

salt + acid = 1753.8

salt = 1753.8 – acid

$$\frac{1753.8 - x}{x} = 1.0 \; 1753.8$$

$$pH = pKa - \log \frac{Base}{acid}$$

$$= 4.756 + \log\left(\frac{0.4999}{0.000}\right)$$

Total molar acid

base

$$\frac{0.2-x}{x} = 0.0175$$

$$0.2 - x = 0.0175x$$

$$0.2 = 0.0175x + x$$

$$0.2 = 1.0175x$$

$$x = \frac{1.0175}{0.2} \qquad \frac{base}{acid} = 1.0175$$

~~(base) + (acid) = 0.2~~

$$base = (0.2 - acid)$$

$$\frac{0.2-acid}{acid} = 1.0175$$

$$0.2 - acid = 1.0175\,acid$$

$$0.2 = 1.0175\,acid + 1\,acid$$

$$= \frac{2.0175}{0.2}$$

$$0.15 - x = 1.58x$$

$$= 1.58x + x$$

$$0.15 = x(1.58+1)$$

$$\frac{0.15}{(1.58+1)} = x$$

$$x = 8$$

$$\frac{base}{acid} = 0.0175380$$

$$base + acid = 0.2$$

base = 0

$$base = 0.2 - acid$$

$$\frac{0.2 - acid}{acid} = 0.01753$$

$$0.2 - acid = acid(0.01753)$$

$$0.2 = acid(0.01753) + acid$$

$$0.2 = acid(1 + 0.01753)$$

$$acid = \frac{0.2}{(1+0.01753)}$$

Task for today:

→ Prepare 1M acetate/acetic acid

→ make calibration curve of adding methanol 50 ppm, 100 ppm, 250 ppm, 500 ppm, 1000 ppm, 20000 ppm, 35000 ppm

→ dilute 10 times.

ppm = mass of solute / mass of so

mass of solute = ppm × mass of solvent / 10^6

$\rho = \frac{m}{V}$

$m = \rho V$

$(\rho V)_{solute}$ = ppm ×

$C_1V_1 = C_2V_2$

1 ppm = 1 ~~ppm~~ gm of ethanol in 1000 ml of solvent

$C_1V_1 = C_2V_2$

100 ppm (V_1) =

0.1 mL of stock (1000 ppm) & make up to 100 ml in standard falask with solvent.

1000 ppm = 1 ml (alcohol) × 999 ml (solvent)

2000 ppm =

$M_1V_1 = M_2V_2$

=

1 ppm = $\frac{1\text{mg}}{1\text{Kg soln}} = \frac{0.001\text{g solute}}{1000\text{g solute}}$ =

$ppm = 10^6$

1 ppm = 0.001 ml/L

2 ml of acetate enough to produce 1 mol of ethane

2M Naacetate produce = 1M ethane

0.119 mol Naacetate / 0.801

1M ethane requires 2M Naac

0.05

2 moles of Naacetate produce 1 mol of ethane

1 mole of Naac

1 mol of ethane needs 2 moles of Naacetate

$CE = \frac{nFz}{It} = \frac{CE \times It}{Fz} =$ n

$n = \frac{100 \times 0.321 \times 3600}{96485\text{C/mol} \times 2} = 0.005980$

n products = 0.59884 mole

$M = \frac{n}{V} = \frac{0.598}{0.1} = 5.98 = 0.05M$

0.05 mol of ethane needs 0.119 mol of Naacetal

1M beja = 0.119 mole

$\left(\frac{1 - 0.119}{1}\right) = 11.9\%$

$n = M \times V$

$= \frac{1M}{L} \times 0.1 = 0.1$ moles

0.95 = 5%

01. = 50mA/cm² | O₂ flowrate | 30ml/min

Velect. 120 ml pH 5 1M Kacetate.

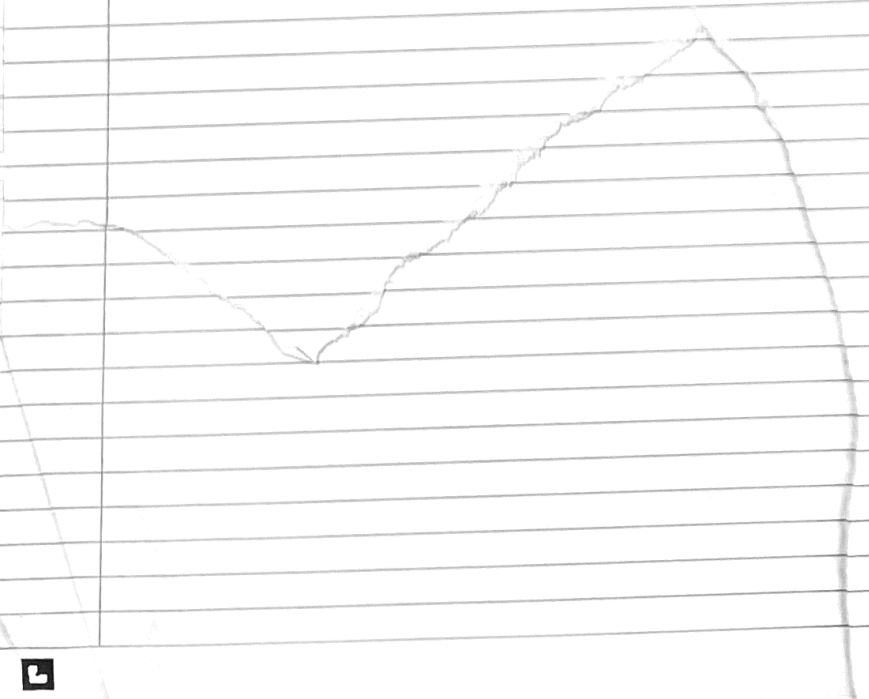
02 - 25mA/cm² 96.7

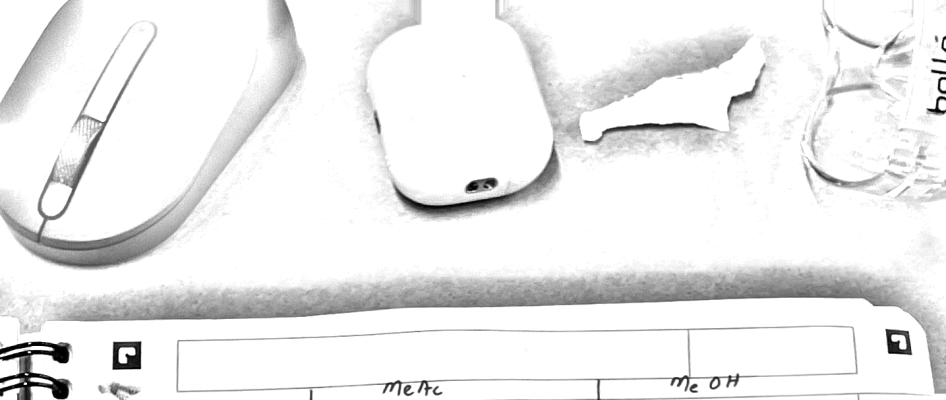
= 3868~~8~~8 mA

O₂ flow rate 50ml/min

3.8688 cm²

Gin Redox. me holder





		MeAc	MeOH
H_2O	201		
181A	202	5064, 4373, 4788	26724, 28967, 29415
182A	203	13674, 13959, 12898	92286, 92580, 94165
H_2O	204		
183A	205	5307, 4854, 4891	26461 30047, 28125, ~~25946~~ 25946
184A	206	8335, 7583, 8605	62347, 58254, 59550
H_2O	207	–	–
185A	208	6851, 7109, 6636	29587, 31165, 27377
186A	209	13770, 12139, 13144	96615, 97329, 96461
H_2O	210	–	–
188A	211	5060, 6318, 5537	29851, 27743, 27183
187A	212	7889, 9840, 9031	57916, 54732, 53888
H_2O	213	–	–
O_2	214	9658, 9331, 8930	40104, 39502, 37722.
O_1	215	14807, 13982, 14996.	72066, 64267, 69742
O_3			
O_4			
O_5			
O_6			
O_7			
O_8			

Role of SECM:

→ the concentration of OH radicals can be detected near the surface by oxidation of trapping agents.

↳ this will be compared with simulated $OH^{\bullet}$ concentrated w.r.t electrode diffusance in presence of organic species and absence of OH radicals.

↳ mode will be used: substrate generation tip collection

→ in presence of methyl radicals, dangling bonds formed due to abstraction of OH radicals scavenged by methyl radical.

This phenomena results in corrosion/graphitisation of diamond electrode, more visible at high current density. (above 100 mA/cm²).

The carbon layer causes the surface blockage, which also results in surface roughness change. This can be visualised by EC-AFM in presence of acetate (different concentration) and different current density.

20230821_part2

		EtOH	EtOH
201	H_2O		
202	P_2	15814, 14815, 18306	8738, 9445, 7193
203	P_4	14998, 15783, 16427	7386, 7867, 8625
204	H_2O		
205	P_6	14058, 13720, 14216	8334, 38, 7497
206	P_8	104967, 104375, 108968	24017, 22157, 23677
207	H_2O	-	
208	193C	NO acid methanol	no MeAc
209	194C	"	"
210	H_2O	-	-
		MeAc	MeOH
211	193A	10607, 10082, 10628	~~95503~~ 96845, 99526, 93429
212	194A	14645, 14072, 13413	101088, 96200, 94279

Experiment RRDE

Base experiment 0.1M Na_2SO_4 (pH 5 , pH 9)

set electrode at constant potential
observe the current at ring
(figure 1)

- step 1

trapping agent 5,5-Dimethyl-1-pyrroline N-oxide
DMPO. (MW = 113.16

Steps
→ ① Prepare the RDE
→ ② prepare the solution
strategy: consider pH 5

① this oxidation occurs at gold electrode.

$[DMPO]^+$ is redox active with E° = 0.85V vs Ag|AgCl

To do:
prepare the RRDE:
→ BDD electrode ✓
→ RDE rotor ✓
→ low volume cell ✓
→ spare. ✓

→ electrodeposition of gold on platinum
→ solution preparation (gold)

electrodeposition = -0.155 V Ag/AgCl

Step:

① make blank CV at 0.5M H_2SO_4 Pt disc ✓
② electrodeposition ✓
③ CV in 0.5M H_2SO_4 for comparison ✓

Blank CV on ring

WE Pt ring
CE: Pt/Ti mesh
RE = Ag/AgCl

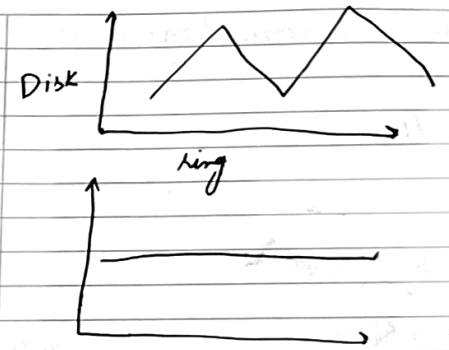
0.1 0.5M H_2SO_4

CV = 0.05 - 1.2 VRHE = -0.16 to 0.99 V Ag/AgCl

0.2 cd:
-0.2 V vs Ag/AgCl (10 mins). $AgCl_4$

03. CV in 0.5M H_2SO_4 for comparison

With CA/CA:



we switch it

Blank experiment

01 : at OCV only 0.1M Na_2SO_4
Ring Au/Pt = -0.4 to 1 V Ag/AgCl
BDD = at 0 CV. at EOC at 1500rpm

02 : at OCV 10mM DMPO with 0.1M Na_2SO_4
at EOC

03: at 1.2V BDD 10mM DMPO

04: at 1.5 V BDD 10mM DMPO

05: at 1.7V BDD 10mM DMPO

06 : at 2.0V BDD 10mM DMPO

07: at 2.5V BDD 10mM DMPO

08 at 3 V BDD 10mM DMPO

with rotation
now do same
without rotation.

0.01

20230824

in previous experiments, the connections were misplaced.

ring was connected to disc

NOW connection is fine

→ new solution 10mM done

→ 01. at OCV at 100rpm & 10 mV/s

02. 1.2V vs Ag/AgCl at 100 rpm & 10 mV/s

03 1.5V vs Ag/AgCl at 100 rpm & 10 mV/s

04 1.7V vs Ag/AgCl at 100 rpm & 10 mV/s

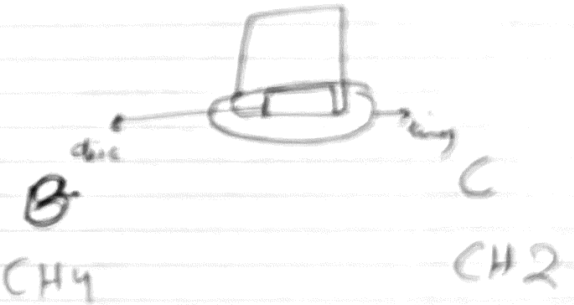
05 2V vs Ag/AgCl at 100 rpm & 10 mV/s

06 2.5 vs Ag/AgCl at 100 rpm & 10 mV/s

07

} 10 mM DMPO in 0.1 M Na_2SO_4 pH 5

Let make a diagram



so i want to do CV on ring (C) CH2
i want to do CP on disc (B) CH4

500 rpm 120mV/s folder.

01. OCV DMPO (10 mM) in 0.1 M Na_2SO_4 ✓
(showing redox activity?) (because of DMPO

02. 1.2 ✓

03 1.5 ✓

04 1.7

05 2

06 2.5

→ no peak because gold layer gone

Try (3)

01 Blank 0mM DMPO in 0.1M Na_2SO_4

-0.045 to 0.935

02_ 1.7 @100 mV/s

03_ 1.7 @ 10mV/s

04_ 2.7 @10mV/s ✓ worked. } 500 rpm

05_ 2.7 @ 50mV/s

06_ 1.7 @50 mV/s

0.6 1.2 @50 mV/s.

07_ 2.7 @ 50mV/s → 1000 rpm

08_ 2.7 @ 50mV/s → 1500 rpm

09_ 2.7 @ 50mV/s → 2000 rpm

10 2.2 @ 50 mV/s → 2K rpm

11: 1.8 @ 50 mV/s → 2K rpm

12: 1.5 @ 50mV/s → 2K rpm

13: 1.1 @ 50mV/s @2K rpm

~~just. 0 rpm.~~

Exp 3 folder

id		BDD (V)	mV/s	rpm	std
01	0.1M Na_2SO_4 pH5 (no dmpo)	OV (ocp)	20mV/s	3000	✓
02	0.1M Na_2SO_4 pH5 (no dmpo)	1.2 V Ag/AgCl	20mV/s	3000	✓
03	0.1M Na_2SO_4 pH5 (20mM DMPO)	OV (ocp)	20mV/s	3000 rpm	✓
04	0.1M Na_2SO_4 pH5 (10mM Dmpo)	1.2 V Ag/Ag	20 mV/s	3000 rpm	✓
05	0.1M Na_2SO_4 (pH5 (10mM Dmpo)	1.5 V Ag/AgCl	20mV/s	3000 rpm	✓
06	0.1M Na_2SO_4 (pH5) (10mM Dmpo)	1.7 V Ag/AgCl	20mV/s	3K rpm	✓
07	0.1M Na_2SO_4 (pH5) (10mM dmpo)	2.1 V Ag/AgCl	20mV/s	3K rpm	✓
08	0.1M Na_2SO_4 (pH5) (10mM dmpo)	2.3 V Ag/AgCl	20mV/s	3K rpm	✓
09	0.1M Na_2SO_4 (pH5) (10mm dmpo	2.5 V Ag/AgCl	20mV/s	3K rpm	✓
10	0.1M Na_2SO_4 (pH5) (10mm dmpo)	2.75 V Ag/AgCl	20mV/s	3K rpm	✓
11	0.1M Na_2SO_4 (pH5) (10mm dmpo)	3V Ag/AgCl	20mV/s	3K rpm	✓
	No rpm				
12	0.1M Na_2SO_4 (10mm	OCV	20 mV/s	0	✓
13	0.1M Na_2SO_4 (10mM)	1.7 V Ag/AgCl	20 mV/s	0	✓
14	0.1 M Na_2SO_4 (10mM)	2.1 V Ag/AgCl	20 mV/s	0	✓
15	0.1M Na_2SO_4 (10mM)	2.3 V Ag/Ag	20 mV/s	0	
16	0.1M Na_2SO_4 (10mM)	2.5 V Ag/Ag	20 mV/s	0	

Exp

17	0.1M Na_2SO_4 10mM DMPO 10mM	OCV	20mV/s	500 rpm ✓
18		1.7		500 ✓
19	"	2.1	20mV/s	500 ✓
20	"	2.3	20mV/s	500 ✓
21	"	2.5		500 ✓
22	"	1.5		500 rpm
23	"	1.2		500 rpm

New electrolyte

23	0.1M Na_2SO_4 12mM dmpo	1.2	20mV/s	rpm ✓
24	0.1M Na_2SO_4 12mM dMPO	1.5	"	500 ✓
25	"	1.7	"	500
26	"	2.1	"	500 ✓
27	"	2.3	"	500
28	"	2.5	"	500
29	"	2.7	"	" ✓
30	"	2.9	"	" ✓
31	"	3.2	"	" ✓

1V

pHs

Scan from 0.935 to -0.350

stat

Exp 4

	Electrolyte	DMPO conc	rpm	scan speed mV/s	BDD 2.5V
①	10mM DMPO in 0.1 Na_2SO_4	10mM	500	20	O2 = 2.5V 2-1 = 1.7 2-2 = 2.1 2-3 = 2.3 2-4 = 2.5 2-5 = 2.7
② Redo	DMPO in 0.1M acetic acid (regain) new electrolyte ⇒ (2-6 = 2.3)	10mM	500	20	
③	DMPO in 0.5M acetic acid	10mM	500rpm	20	O3 = 2.3(2.1) O3 2.3 O3-1 = 2.3V O3-2 = 2.5
④	DMPO in 1M acetic acid	10mM	500rpm	20	O4 = 2.3V O4_1 = 2.1V O4_2 = 2.5
⑤	DMPO in 0.1M propionic acid				
⑥	DMPO in 0.5M propionic acid				
⑦	DMPO in 1M propionic acid				
⑧ →	0.1M propionic acid blank				
⑨ →	0.5M propionic acid blank				
⑩ →	1M propionic acid blank				
✓⑪	0.1M acetic acid blank (11_1) new electrolyte (2.3) ✓				2.5
⑫	0.5M molar acid acid blank				2.3
✓⑬	1M acetic acid blank				2.7

Content.

Introduction
Materials and methods
Results and discussion
Conclusions

Result:

→ OH radicals detection by RRDE : DMPO (acetic acid, propionic acid)
→ ECMS : acetic acid, propionic acid, glucose
  → mixture of acetic acid, propionic acid, glucose, eugenol
→ Batch vs flow :
  ↳ divided vs undivided.
→ effect of molecular oxygen.
→ OH radicals concentrations (CFD & python)
→ Effect of oxidant (OH radicals, sulfates, chlorates)
→ Effect of current density
→ Effect of membrane (due to cell design, i suspect that OH° radicals can affect the membrane
→ Limitations of carbon based electrodes
→ BDD corrosion :
→ Influence of process parameters.

GA
Pu
GI

AA+Pu
1A+Cu

Pu + Cu
Pyran

$$C_{SOH} = \sqrt[3]{\frac{j^2}{2.67 \times F^2 K_{HO} \cdot D_{HO}}}$$

$$C_{SOH} = \sqrt[3]{\frac{300}{2.67 \times 96485^2 \times 5.5 \times 10^9 \times 2.2 \times 10^{-9}}}$$

$$\frac{A/m^2}{C/mol \times \frac{m^2 \times m}{s}}$$

$$\frac{m^3}{mol \cdot s} \quad 5.1 \quad 0.05$$

$$C_{AOH} = \sqrt[3]{\frac{j^2}{2.67 F^2 K_{H_2O} \cdot D_{HO}}}$$

$$C_{HO} = \frac{3 D_{HO}}{2 K_{HO}\left(x + \sqrt{\frac{3 D_{HO}}{2 K_{HO} \times C^{s}_{HO}}}\right)^2}$$

$$C_{SOH} = \frac{3 D_{HO}}{2 K_{HO}\left(x + \sqrt{\frac{3 D_{HO}}{2 K_{HO} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{H_2O} D_{HO}}}}}\right)^2}$$

$$C_{SOH} = \frac{3 D_{HO}}{2 K_{HO}\left(x + \sqrt{\frac{3 D_{HO}}{2 K_{HO} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{HO} \cdot D_{HO}}}}}\right)^2}$$

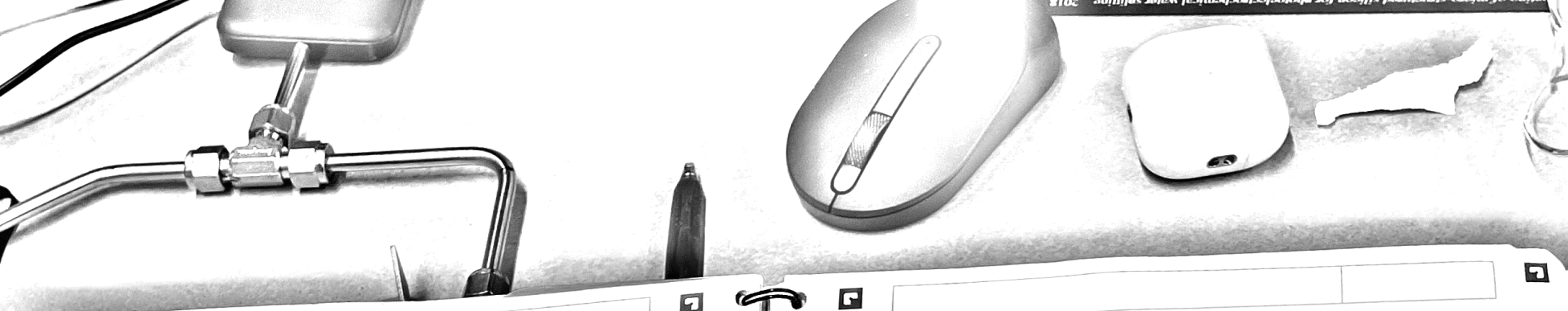
$$C_{SOH} = \frac{3 D_{HO}}{2 K_{HO}} \cdot \left(x + \sqrt{\frac{3 D_{HO}}{2 K_{OH} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{HO} \cdot D_{HO}}}}}\right)^{-2}$$

$$C_{SOH} = \frac{3 D_{HO}}{2 K_{HO}}\left(\left(x + \left(\frac{3 D_{HO}}{2 K_{OH} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{HO} \cdot D_{HO}}}}\right)^{1/2}\right)^{2}\right)^{-1}$$

$$= \frac{3 D_{HO}}{2 K_{HO}}(x)^{-2} + \left(\frac{3 D_{HO}}{2 K_{OH} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{OH} \times D_{OH}}}}\right)$$

$$= \frac{3 D_{HO}}{2 K_{HO} \times x} + \left(\frac{2 K_{OH} \times \sqrt[3]{\frac{j^2}{2.67 \times F^2 \times K_{OH} \times D_{OH}}}}{3 D_{HO}}\right)$$

$$= \frac{3 D_{HO}}{2 K_{HO} \times x} + \left(\frac{2 K_{OH} \times \left(\frac{j^2}{2.67 \times F^2 \times K_{OH} \times D_{OH}}\right)^{1/3}}{3 D_{OH}}\right)$$



EtOH

5mM 40ml = 0.009212g = 0.0116N = 11.6 µl

50mM 40ml = 0.0921 116 µl

EtPr

5mM 40ml 0.0204 = 0.0230ml 23 µl

50mM 40ml 0.204 230 µl

MeOH µl

5mM 40ml = 0.0064g = 0.008081ml = 8.08 = 80µl

50mM 40ml = 0.0640g

MeAc

5mM 40ml = 0.01481 = 0.01588ml = 15.8 µl

50mM 40ml = 0.14816g 158.8µl

Eugenol

15ml → 10mM eugenol

0.02309ml = 23 µl

	Cat id		Ref	Acc
210	1	Eugenol 10mM	(31.8-32.1)	3533900, 5548347
214	2	Ethanol 5mM	(5.4-6.4)	1540026, 1602342
208	3	EtOH 50mM	(5.4-6.4)	3563595, 3444276
209	4	MeAc 5mM	(3.6-3.9)	308478, 312466
212	5	MeAc 50mM	(3.55-3.9)	3041366, 3182809
211	6	EtPro 5	(5.8-63)	773443, 1166546
213	7	EtPro 50		7810727, 9628013
216	8	MeOH 5	(4.6-5.3)	380796, 372840
215	9	MeOH 50	(4.6-5.7)	

Problem:

eugenol detected but not

other peaks coincides.

19-09-2023

Calibration bottle: mix gases (1000ppm each in Helium.

Methane	0.811
Ethylene	0.564
Ethane	0.547
Propylene	→ didn't see
Propane	0.671
i-butane	0.958
n-butane.	1.004

Katijah Sample

201 - CO
202 - C1
203 - C2
204 - C3
205 - C4
206 - C5

20230920

Ergonol boiling point = 254°C

inject port → 225°C
detector 270°C

New method

			Retten	integration	Curve area
201	H2O				
202	3	EtOH	4.6	(4.5-4.9)	2510081, 2476947
203	4	MeAc	3.81	(3.75-3.97)	242009, 234001
204	5	MeAc		3.75-3.97	2343779, 2326069
205	H2O				
206	6	EtPro	4.785	14.72-4.98)	502327, 505690
207	7	EtPro			5203927, 5064760
208	2	EtOH			465179, 465400
209	9	MeOH	4.285	4.2-4.5.	1075201, 1058645
210	8	MeOH			125537, 126563.

Since EtPro and ethanol overlap so i take the integration event (4.5 to 4.7) for ethanol, so the areas are here

			Ret'n	int	
202	3	EtOH)	4.6	(4.5-4.71)	2121742, 2111868
208	2	"	4.6	"	321106, 323806

test

			Retten
P3:	EtOH:	97397	4.6
	EtPro:	22120	4.84

Calibration coefficient:
Methanol: 1e-8
Ethanol: 3e-8
EtPro : 1e-8
MeAc : 2e-8