BOOK 4
Talal_

AURORA 80g

Wiktoria experiment continue

W195

25 : 0.079
100 : 0.314A

Cellfion membrane =
BDD: WE
CE = SS mesh
flow rate = 10 ml/min
electrolyte both sides 1M acetic acid / Na acetate = 80ml each side
electrolysis time = 1hr = 25 mA/cm² = 0.079A

W196

Same experiment, flow rate, electrolyte, volume as W195,

Current density different

100 mA/cm² ⇒ 0.314 A 1hr.

Run 1

pulse
divided
1M acetic acid
BDD on both sides — 25 - 50 mA/cm²
0.265A — 1hr

0.132 w/o stirring

electrolyte volume = 80ml

Current number → loop start] loop
End number → loop end]
Cycles → 9999, → how many times loops go
End state : last

Run 2

Same conditions but with stirring.

Progress meeting

→ BDD pillar electrode
→ Paper chemelectrochem
→ paper mix acid

→ step:

① Melt

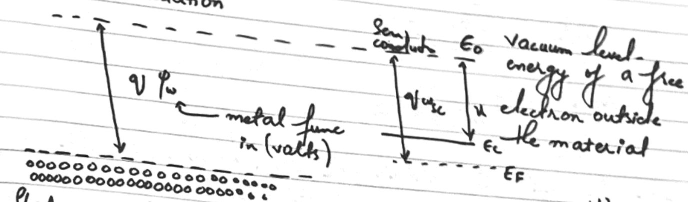
characterize electrode

- → ✓SEM → completed
- → Mott shotcky →
- → EC-AFM
- • SEM-Raman
- → SIMS
- → ECMS
- → 3D structures →
- → grain size distribution
- → grain density with variable length

Mott shott

→ terms
fermi level and vacuum level.
Valence band
Conduction band
doped density
p type
n type

Metal in isolation



States are filled up to fermi level E_F

φ_m	
Au	5.1 eV
Pt	5.7 eV
Pd	5.1 eV
W	4.6 eV

Electronic property of semi conductor material is analyze by Mott schottky
↳ gives information
- Carrier concentration
- doping profile
- flat band potential

χ
Si = 4.05 eV : Semi conductor
SiO_2 = 0.95 eV insulator

→ Semiconductor electrochemistry is complicated by appearance of space charge region that extends from surface to material itself.
During MS, it is the capacitance of space charge region which is probed

$$\frac{1}{C_{sc}^2} = \frac{2}{\epsilon\epsilon_0 A^2 e N_D}\left(E - E_{FB} - \frac{kT}{e}\right)$$

ϵ → dielectric constant of material.
ϵ_0 → $(8.85 e^{-12} F m^{-1})$ is the vacuum permitivity, $A(m)$ expose area of material, e $(1.6 e^{-19} C)$ is electric charge, N_D → doping density
E → applied DC offset, E_{FB} → flatband potential,

k ($1.38e^{-23}$ JK^{-1}) is the boltzman constant, $T(K)$ = temperature

Plot of $1/C_{sc}^2$ vs E allows both N_D &, E_{FB} to be calculated from the slope and intercept of x-axis.

$$\text{intercept} = E_{FB} + \frac{kT}{e}$$

$$\text{intercept} - \frac{kT}{e} = E_{FB}$$

$$\text{slope} = \frac{2}{\epsilon\epsilon_0 A^2 e N_D}$$

$$N_D = \frac{2}{\epsilon\epsilon_0 A^2 e \times \text{slope}}$$

EIS can be used to obtain the capacitance of the space charge region assuming that the chosen frequency is sufficiently high (kHz) kHz.

$$\frac{1}{C_s^2} = (-\omega Z'')^2$$

$$\frac{1}{C_p^2} = \left(\frac{(-Z''^2 + (Z' - R_s)^2 \omega}{-Z''}\right)^2$$

$-Z''$: imaginary impedance

ω : angular frequency

R_s = serial (uncompensated) resistance

$1/C_s^2$ = capacitance of modelled by series connection R_s-C_s.

$1/C_p^2$: capacitance " " parallel " $R_s - C_p/R_p$

Calibration H_2O_2

Calibration method:

$2M\ H_2SO_4$ = 1088 ml in 100 ml

$0.1\ M\ TiOSO_4$ = 7.83 ml

UV-vial

$0.1\ M\ TiOSO_4$ + $2M\ H_2SO_4$ (975 μl) → vial ← 25 μl analyte

Calibration vial (10 ml)

Conc mM	H_2O_2 μl	$2M\ K_2CO_3$ make up till 10 ml
0	0	10 ml make up
2	2.04 μl	
5	5.102 μl	
10	10.204 μl	
20	20.408 μl	
60	61.224 μl	
80	81.633 μl	
100	102.041 μl	

Calibration pump

H_2O = 100 ml

rpm	time (min)	sec
50	2	52
100	1	25
200	0	44
350	0	24

Flow rate = 0.0118 × RPM (ml/sec)
= 0.7061 × RPM (ml/min)

Calibration by Rodeo.

full open vile:

	$2 M K_2CO_3$	absorbance
Blank		0
2 mM		0.06
5 mM		0.02
10 mM		0.38
20 mM		0.38
60 mM		0.90
80 mM		1.11
100 mM		1.[illegible]

→ absorbance at 415 nm (y) and concentration (x)

$y = 101.52x + (-29.63)$ $R^2 = 0.9954$

mM = 101.52 × 0.17 − 29.63
= 17.[illegible] mM

$\frac{nFZ}{It}$ =

Z. Liu et al: Carbon

→ MS plots: 0.1M KNO_3 solution ($-0.4V$ to $0.8V$) at frequency of 160 Hz, charge carrier concentration

$$N_A = -2 / (e \varepsilon_0 \varepsilon_r A^2 [d(C_p^{-2})/dE]$$

C_p evaluated from EIS data (1 Hz to 25 kHz at 10 mV and fitted with randles)

→ C_{dl} = CV in 0.1M KNO_3 in 0 – 1.0V

$$C_{dl} = \Delta I_{AV} / A_{geo} \times V$$

ΔI_{AV} (in A) is average background current diff between forward and backward scan at +0.5V, A_{geo} = geometric area, V is scan rate (0.1V/s)

Flat BDD On Si

High doped area 16.5mm x 20.4mm

low doped area 18.7 x 18.93mm