



Appendix

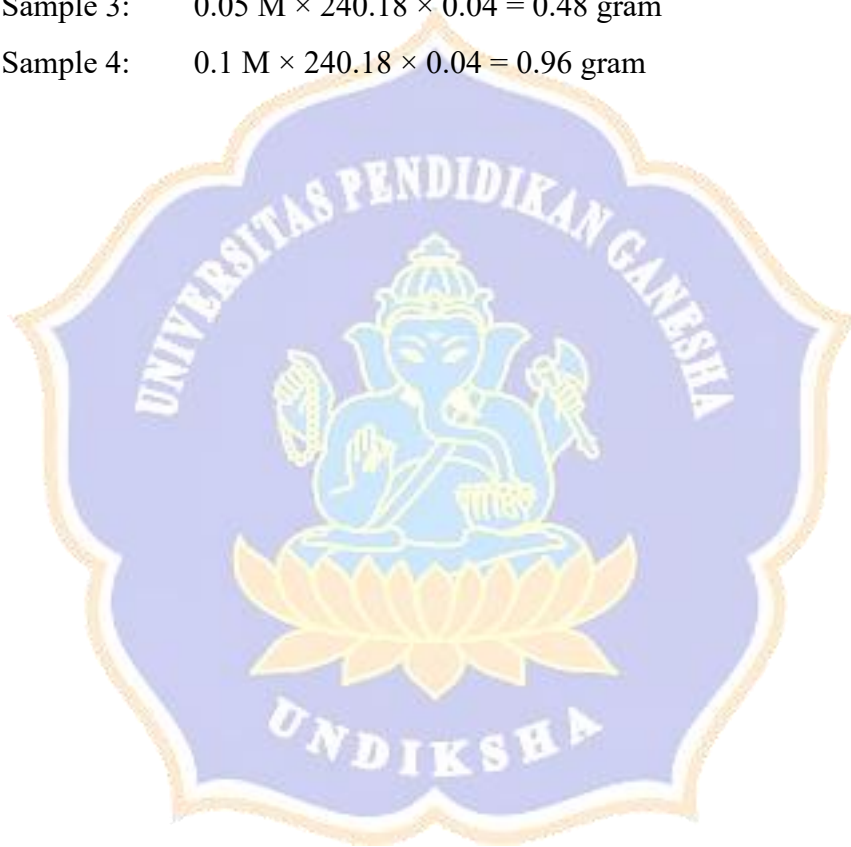
Appendix 1. Weight of material and reagents

Calculate weight of FeSO₄: concentration × FW × DI water (Liter)

$$0.0625 \text{ M} \times 278.02 \times 0.04 = 0.695 \text{ gram}$$

Calculate weight of Sodium Sulfide Nonahydrate: concentration × MW × DI water (Liter)

- Sample 1: $0.0125 \text{ M} \times 240.18 \times 0.04 = 0.12 \text{ gram}$
- Sample 2: $0.025 \text{ M} \times 240.18 \times 0.04 = 0.24 \text{ gram}$
- Sample 3: $0.05 \text{ M} \times 240.18 \times 0.04 = 0.48 \text{ gram}$
- Sample 4: $0.1 \text{ M} \times 240.18 \times 0.04 = 0.96 \text{ gram}$



Appendix 2. Cyclic voltammograms curve for OER

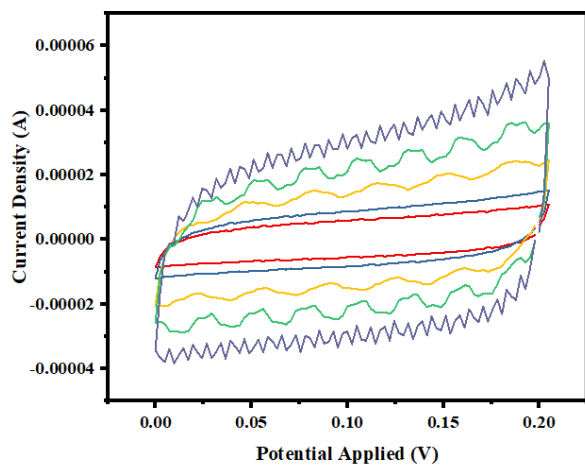


Figure 33. Cyclic voltammograms iron hydroxide

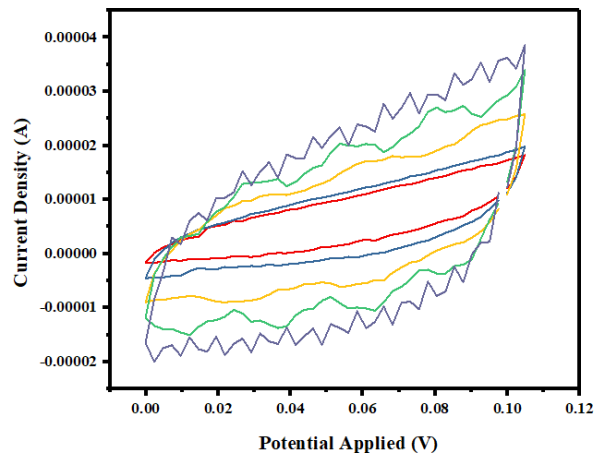


Figure 34. Cyclic voltammograms sample 1

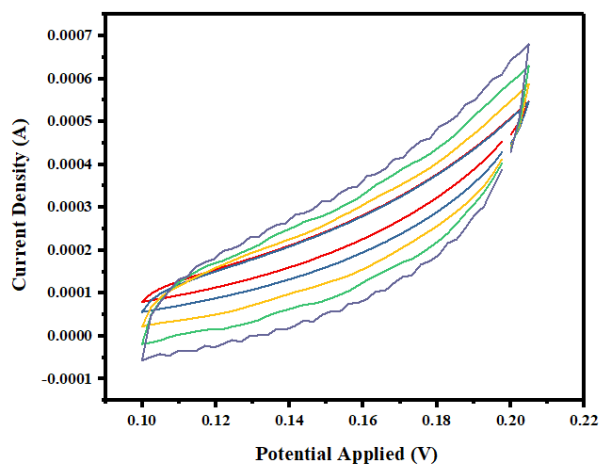


Figure 35. Cyclic voltammograms sample 2

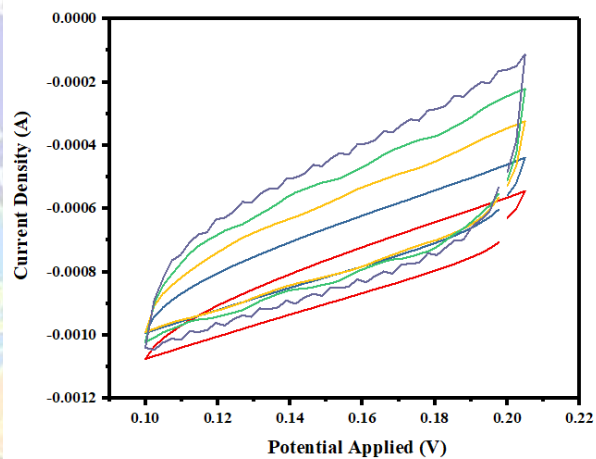


Figure 36. Cyclic voltammograms sample 3

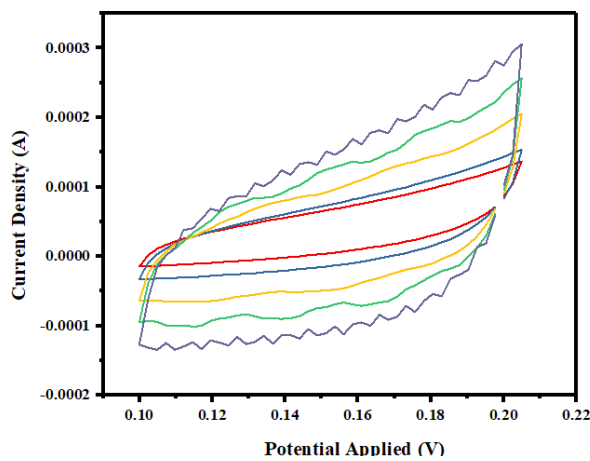


Figure 37. Cyclic voltammograms sample 4

Appendix 3. Cyclic voltammograms curve for HER

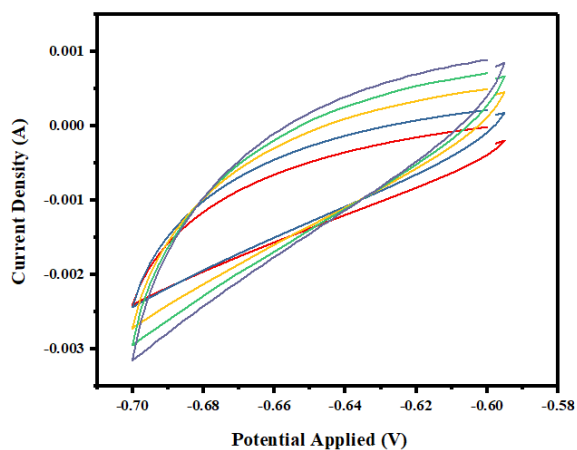


Figure 38. Cyclic voltammograms iron hydroxide

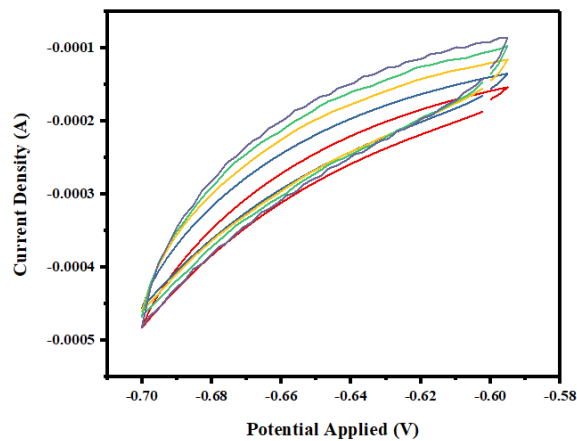


Figure 39. Cyclic voltammograms sample 1

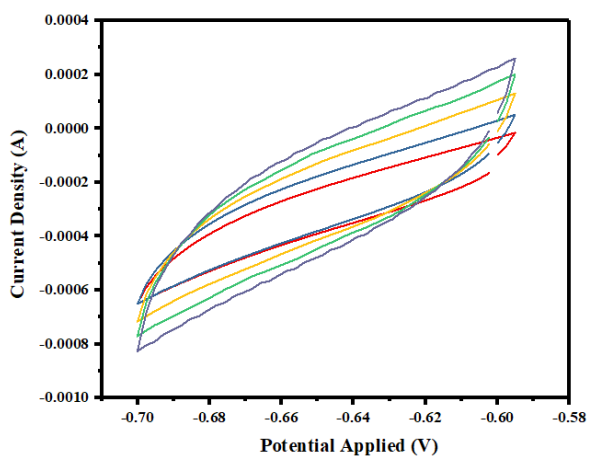


Figure 40. Cyclic voltammograms sample 2

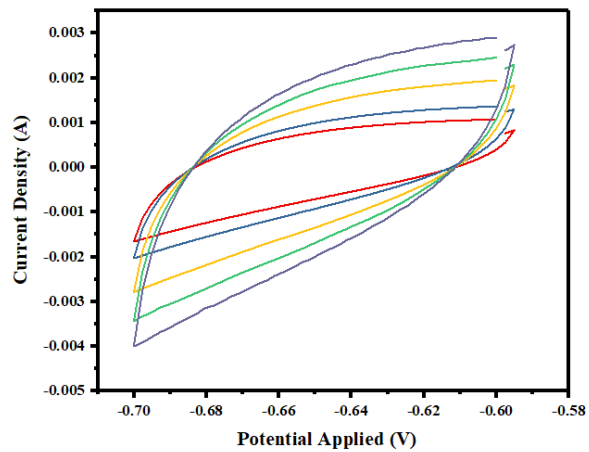


Figure 41. Cyclic voltammograms sample 3

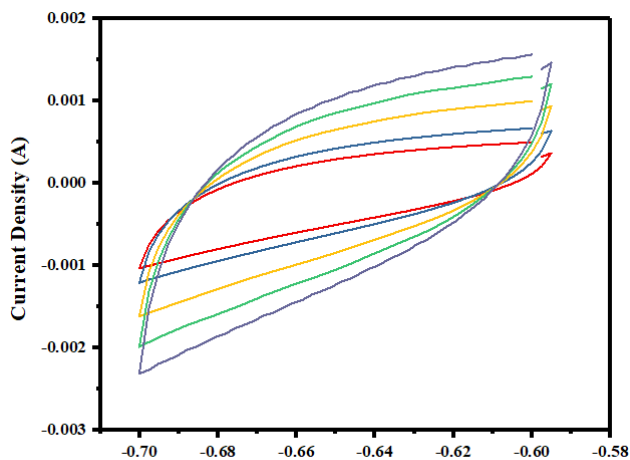


Figure 42. Cyclic voltammograms sample 4

Appendix 4. Table fitting curve of cyclic voltammograms

Table 7. Fitting curve of cyclic voltammograms for HER

Equation	Y=a + b*x				
Plot	Fe(OH) ₂	Fe _x S _y 0.0125 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.025 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.05 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.1 M <i>Na₂S · 9H₂O</i>
Weight	No Weighting				
Intercept	-0.25355 ± 0.46415	0.41675 ± 0.01987	1.2033 ± 0.08328	1.1065 ± 0.09362	0.57505 ± 0.0601
Slope	0.05828 ± 0.00808	0.0095 ± 3.45917E-4	0.03471 ± 0.00145	0.03275 ± 0.00163	0.01887 ± 0.00105
Residual Sum of Squares	0.78342	0.00144	0.02522	0.03187	0.01314
Pearson's r	0.97235	0.99802	0.99739	0.99631	0.99542
R-Square (COD)	0.94547	0.99604	0.99479	0.99263	0.99087
Adj. R-Square	0.9273	0.99472	0.99306	0.99017	0.98782

Table 8. Fitting curve of cyclic voltammograms for OER

Equation	$Y=a + b*x$				
Plot	$Fe(OH)_2$	Fe_xS_y 0.0125 M $Na_2S \cdot 9H_2O$	Fe_xS_y 0.025 M $Na_2S \cdot 9H_2O$	Fe_xS_y 0.05 M $Na_2S \cdot 9H_2O$	Fe_xS_y 0.1 M $Na_2S \cdot 9H_2O$
Weight	No Weighting				
Intercept	-0.03515 ± 0.46109	0.33465 ± 0.13677	0.10935 ± 0.13893	0.7706 ± 0.2753	0.24115 ± 0.12108
Slope	0.06721 ± 0.00803	0.03783 ± 0.00238	0.02916 ± 0.00242	0.03746 ± 0.00479	0.02655 ± 0.00211
Residual	0.77312	0.06802	0.07019	0.2756	0.05331
Sum of Squares					
Pearson's r	0.97927	0.99411	0.98984	0.97632	0.99067
R-Square (COD)	0.95897	0.98826	0.97979	0.9532	0.98144
Adj. R-Square	0.9453	0.98435	0.97305	0.9376	0.97525

Appendix 5. Fitting curve for Impedance

Table 9. Fitting curve of EIS for HER

Model	Impedance				
Equation	$y_0 + (((r^2) - ((x - x_0))^2)^{1/2})$				
Plot	Fe(OH) ₂	Fe _x S _y 0.0125 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.025 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.05 M <i>Na₂S · 9H₂O</i>	Fe _x S _y 0.1 M <i>Na₂S · 9H₂O</i>
y ₀	-27.82068 ± 2.70201E6	1.92948 ± --	1.47416 ± --	1.17476 ± 1.66496E6	0.85211 ± 3.89415E6
x ₀	8.95435 ± 0.05914	9.9224 ± 0.04708	9.64493 ± 0.04509	11.75335 ± 0.03734	11.4719 ± 0.03997
r	7.70632 ± 349747.76426	0.59048 ± --	0.69867 ± --	1.20675 ± 1.37627E6	1.38972 ± 2.79512E6
Reduced Chi-Sqr	0.10375	0.10009	0.06389	0.05909	0.05387
R-Square (COD)	-0.23637	0.5288	0.44625	0.79729	0.73522
Adj. R- Square	-0.37374	0.48597	0.39351	0.7804	0.71115

Table 10. Fitting curve of EIS for OER

Model	Impedance				
Equation	$y_0 + (((r^2) - ((x - x_0))^2)^{1/2})$				
Plot	Fe(OH) ₂	Fe _x S _y 0.0125 M Na ₂ S · 9H ₂ O	Fe _x S _y 0.025 M Na ₂ S · 9H ₂ O	Fe _x S _y 0.05 M Na ₂ S · 9H ₂ O	Fe _x S _y 0.1 M Na ₂ S · 9H ₂ O
y ₀	305.22777 ± --	3.64962 ± --	7.13753 ± 2.4053E7	6.14417 ± --	4.26145 ± 9.4583E6
x ₀	42.85799 ± 1.50719	4.94329 ± 0.12879	6.50339 ± 0.20056	6.41334 ± 0.19293	4.88194 ± 0.12974
r	32.36815 ± --	3.26463 ± --	4.58566 ± 5.23218E6	4.1394 ± --	3.40926 ± 2.76738E6
Reduced Chi-Sqr	36270.01156	1.73958	15.41555	14.55268	5.08518
R-Square (COD)	-0.96078	0.75374	0.21603	-0.37308	-0.08105
Adj. R- Square	-1.03341	0.74525	0.189	-0.42043	-0.11833