APPENDIX A

The voltammograms shown here were obtained from cyclic voltammetry with five different scan rates. The scan rate are, 16 mV/s, 64 mV/s, 144 mV/s, 256 mV/s and 400 mV/s. The experiment conditions are listed below:

Working Electrode: Vitreous or Glassy Carbon Electrode.
Reference Electrode: Silver/Silver Chloride
Bath Solution: 0.3 M copper (II) sulphate and 2.2 M sulphuric acid.
Potential, V

04-Jan-80
15:46:36
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 16
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -469
ip (A) = +3.2864E-3

Segment 2:
Ep (mV) = +100
ip (A) = -2.5038E-2
Potential, V

04-Jan-80
15:50:15
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 64
Sweep Segments = 2
Ampl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -525
ip (A) = +5.8377E-3

Segment 2:
Ep (mV) = +123
ip (A) = -2.8728E-2
04-Jan-80
15:51:54
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 144
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -581
ip (A) = +9.0320E-3

Segment 2:
Ep (mV) = +143
ip (A) = -3.5371E-2
04-Jan-80
15:53:56
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 256
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -629
ip (A) = +1.0988E-2

Segment 2:
Ep (mV) = +146
ip (A) = -3.8443E-2
Potential, V

04-Jan-80
15:55:24
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 400
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -656
ip (A) = +1.4870E-2

Segment 2:
Ep (mV) = +148
ip (A) = -4.7935E-2
APPENDIX B

The voltammograms shown here were obtained from cyclic voltammetry with four different scan rates. The scan rate are, 16 mV/s, 64 mV/s, 144 mV/s and 256 mV/s. The experiment conditions are listed below:

Working Electrode: Glassy Copper Electrode.
Reference Electrode: Silver/Silver Chloride
Bath Solution: 0.3 M copper (II) sulphate and 2.2 M sulphuric acid.
04-Jan-80
12:12:53
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 16
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-3

Segment 1:
Ep (mV) = -357
ip (A) = +1.1082E-3
04-Jan-80
2:42:19
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
(V/s) = 64
Sweep Segments = 2
Ampl Int (mV) = 1
Ampl T (s) = 2
Rents (A/V) = 1E-2

Segment 1:
Ep (mV) = -372
ip (A) = +4.7286E-3
04-Jan-80
12:41:07
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 144
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -421
ip (A) = +8.7408E-3
04-Jan-80
12:39:46
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 256
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -540
ip (A) = +1.3296E-2
APPENDIX C

The voltammograms shown here were obtained from cyclic voltammetry with five different scan rates. The scan rate are, 16 mV/s, 64 mV/s, 144 mV/s, 256 mV/s and 400 mV/s. The experiment conditions are listed below:

- **Working Electrode:** Vitreous or Glassy Carbon Electrode.
- **Reference Electrode:** Silver/Silver Chloride
- **Bath Solution:** 0.3 M copper (II) sulphate, 2.2 M sulphuric acid and 0.0003 M Glycine.
04-Jan-80
10:27:12
Mode: CV

Unit E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 16
Sweep Segments = 2
 ampl Int (mV) = 1
quiet T (s) = 2
 sen s (A/V) = 1E-2

Segment 1:
Ep (mV) = -514
ip (A) = +3.2025E-3

Segment 2:
Ep (mV) = +40
ip (A) = -1.7202E-2
Potential, V

Segment 1:
Ep (mV) = -568
ip (A) = +6.1397E-3

Segment 2:
Ep (mV) = +108
ip (A) = -2.8944E-2
Potential, V

04-Jan-80
10:32:44
Mode: CV

Unit E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 144
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -608
ip (A) = +8.6138E-3

Segment 2:
Ep (mV) = +126
ip (A) = -3.4419E-2
04-Jan-80
0:34:15
Mode: CV

Segment 1:
Ep (mV) = -645
ip (A) = +1.0947E-2

Segment 2:
Ep (mV) = +144
ip (A) = -3.9034E-2
Potential, V

04-Jan-80
10:35:48
Mode: CV

Segment 1:
Ep (mV) = -683
ip (A) = +1.3611E-2

Segment 2:
Ep (mV) = +160
ip (A) = -4.3376E-2

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 400
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2
APPENDIX D

The voltammograms shown here were obtained from cyclic voltammetry with five different scan rates. The scan rate are, 16 mV/s, 64 mV/s, 144 mV/s, 256 mV/s and 400 mV/s. The experiment conditions are listed below:

Working Electrode: Glassy Copper Electrode.
Reference Electrode: Silver/Silver Chloride
Bath Solution: 0.3 M copper (II) sulphate, 2.2 M sulphuric acid and 0.0003 M Glycine.
04-Jan-80
13:15:03
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 16
Sweep Segments = 2
Smp Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -330
ip (A) = +4.4246E-3

Segment 2:
Ep (mV) = +166
ip (A) = -3.4463E-2
04-Jan-80
13:26:07
Mode: CV

Segment 1:
$E_p \text{ (mV)} = -396$
$
\text{ip } \text{(A)} = +1.1157 \times 10^{-2}$

unit $E \text{ (mV)} = 200$
high $E \text{ (mV)} = 200$
low $E \text{ (mV)} = -1000$
unit P/N = N
V $\text{ (mV/s)} = 64$
Sweep Segments = 2
Sample Int $\text{ (mV)} = 1$
Quiet T $\text{ (s)} = 2$
Sens (A/V) = 1E-2
04-Jan-80
13:20:35
Mode: CV

Unit E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 144
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -490
ip (A) = +1.9097E-2
04-Jan-80
13:22:20
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000

Init P/N = N

V (mV/s) = 256
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-2

Segment 1:
Ep (mV) = -485
ip (A) = +1.8065E-2
04-Jan-80
13:25:21
Mode: CV

Unit E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 400
Sweep Segments = 2
Sweep Init (mV) = 1
Sweep T (s) = 2
Sens (A/V) = 1E-2
APPENDIX E

The voltammograms shown here were obtained from cyclic voltammetry with three different scan rates. The scan rate are, 1 mV/s, 4 mV/s and 9 mV/s. The experiment conditions are listed below:

Working Electrode: Vitreous or Glassy Carbon Electrode.
Reference Electrode: Silver/Silver Chloride
Bath Solution: 2.2 M sulphuric acid and 0.0003 M Glycine.
Potential, V

04-Jan-80
12:52:07
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -600
Init P/N = N
V (mV/s) = 1
Sweep Segments = 2
Sample Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-6

Segment 1:
Ep (mV) = -360
ip (A) = +1.4763E-7

Segment 2:
Ep (mV) = +17
ip (A) = -1.0743E-7

Ep (mV) = +147
ip (A) = -6.8315E-8
04-Jan-80
12:25:55
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -600
Init P/N = N
V (mV/s) = 4
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-6

Segment 1:
Ep (mV) = -217
ip (A) = +2.3267E-7
04-Jan-80
12:35:10
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -600
Init P/N = N
V (mV/s) = 9
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-6

Segment 1:
Ep (mV) = -240
ip (A) = +3.0687E-7
APPENDIX F

The voltammograms shown here were obtained from cyclic voltammetry with three different scan rates. The scan rate are, 16 mV/s, 64 mV/s and 400 mV/s. The experiment conditions are listed below:

Working Electrode: Glassy Copper Electrode.
Reference Electrode: Silver/Silver Chloride
Bath Solution: 2.2 M sulphuric acid and 0.0003 M Glycine.
04-Jan-80
11:53:13
Mode: CV

Unit E (mV) = 200
-High E (mV) = 200
-Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 16
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-3

Segment 1:
Ep (mV) = -151
ip (A) = +1.0872E-2
Segment 1:
Ep (mV) = -206
ip (A) = +1.3409E-2

04-Jan-80
11:56:19
Mode: CV

Unit E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Unit P/N = N
V (mV/s) = 64
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-3
04-Jan-80
11:58:12
Mode: CV

Init E (mV) = 200
High E (mV) = 200
Low E (mV) = -1000
Init P/N = N
V (mV/s) = 144
Sweep Segments = 2
Smpl Int (mV) = 1
Quiet T (s) = 2
Sens (A/V) = 1E-3

Segment 1:
Ep (mV) = -270
ip (A) = +1.6974E-2
APPENDIX G

SEM images for A1, A2, A3, A4 and A5

Sample Name: A1

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Potential, -0.100 V

Filename: 1050

Magnification: 801 X
Sample Name: A2

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Potential, - 0.200 V

Filename: 1056

Magnification: 3.57 K X
Sample Name: A3

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Potential, - 0.300 V

Filename: 1057

Magnification: 8.31 K X
Sample Name: A4

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Potential, - 0.400 V

Filename: 1059

Magnification: 3.53 K X
Sample Name: A5

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Potential, - 0.500 V

Filename: 1061

Magnification: 4.67 K X
APPENDIX H

SEM images for A6, A7, A8, A9, A10 and A11

Sample Name: A6

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$

Plating Condition: Constant Current, + 1 mA or

Current Density = 1.32 A/cm$^2$

Filename: 1087

Magnification: 3.81 K X
Sample Name: A7
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: Cu$^{2+}$, H$_2$SO$_4$
Plating Condition: Constant Current, + 3 mA or
   Current Density = 3.97 A/cm$^2$
Filename: 1091
Magnification: 904 X
Sample Name: A8
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: Cu$^{2+}$, H$_2$SO$_4$
Plating Condition: Constant Current, + 5 mA
Current Density = 6.22 A/cm$^2$
Filename: 1093
Magnification: 1.85 K X
Sample Name: A9
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: Cu$^{2+}$, H$_2$SO$_4$
Plating Condition: Constant Current, -5 mA or
  Current Density = -6.22 A/cm$^2$
Filename: 1096
Magnification: 15.61 K X
Sample Name: A10

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu^{2+}, H_2SO_4

Plating Condition: Constant Current, -1 mA or

Current Density = -1.32 A/cm^2

Filename: 1102

Magnification: 803 X
Sample Name: A11

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, $\text{H}_2\text{SO}_4$

Plating Condition: Constant Current, -3 mA or

Current Density = -3.97 A/cm$^2$

Filename: 1107

Magnification: 801 X
APPENDIX I

SEM images for B1, B2, B3, B4 and B5

Sample Name: B1

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Potential, - 0.100 V

Filename: 1113

Magnification: 100 X
Sample Name: B2

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu^{2+}, H_2SO_4, Glycine

Plating Condition: Constant Potential, -0.200 V

Filename: 1110

Magnification: 8.02 K X
Sample Name: B3

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Potential, - 0.300 V

Filename: 1117

Magnification: 101 X
Sample Name: B4

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu^{2+}, H_2SO_4, Glycine

Plating Condition: Constant Potential, - 0.400 V

Filename: 1139

Magnification: 8.11 K X
Sample Name: B5

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Potential, - 0.500 V

Filename: 1143

Magnification: 801 X
SEM images for A

Sample Name: A

Working Electrode: Glassy Copper

Reference Electrode: Nil

Bath Solution: Nil

Plating Condition: Nil

Filename: 1147

Magnification: 812 X
APPENDIX K

SEM images for B6, B7, B8, B9, B10 and B11

Sample Name: B6

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Current, + 1 mA or

Current Density = 1.32 A/cm$^2$

Filename: 1151

Magnification: 803 X
Sample Name: B7

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu\textsuperscript{2+}, H\textsubscript{2}SO\textsubscript{4}, Glycine

Plating Condition: Constant Current, - 1 mA or

Current Density = -1.32 A/cm\textsuperscript{2}

Filename: 1160

Magnification: 795 X
Sample Name: B8

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Current, + 3 mA or

Current Density = 3.97 A/cm$^2$

Filename: 1162

Magnification: 806 X
Sample Name: B9

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu^{2+}, H_2SO_4, Glycine

Plating Condition: Constant Current, - 3 mA or

\[
\text{Current Density} = -3.97 \text{ A/cm}^2
\]

Filename: 1165

Magnification: 106 X
Sample Name: B10

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu$^{2+}$, H$_2$SO$_4$, Glycine

Plating Condition: Constant Current, + 5 mA or

Current Density = 6.22 A/cm$^2$

Filename: 1170

Magnification: 795 X
Sample Name: B11

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: Cu\textsuperscript{2+}, H\textsubscript{2}SO\textsubscript{4}, Glycine

Plating Condition: Constant Current, -5 mA or

Current Density = -6.22 A/cm\textsuperscript{2}

Filename: 1174

Magnification: 8.05 K X
APPENDIX L

SEM images for C1, C2, C3, C4 and C5

Sample Name: C1

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: H₂SO₄, Glycine

Plating Condition: Constant Potential, - 0.100 V

Filename: 0901

Magnification: 801 X
Sample Name: C2
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H₂SO₄, Glycine
Plating Condition: Constant Potential, - 0.200 V
Filename: 0902
Magnification: 99 X
Sample Name: C3
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H$_2$SO$_4$, Glycine
Plating Condition: Constant Potential, - 0.300 V
Filename: 0905
Magnification: 101 X
Sample Name: C4
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H₂SO₄, Glycine
Plating Condition: Constant Potential, - 0.400 V
Filename: 0907
Magnification: 100 X
Sample Name: C5

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: H₂SO₄, Glycine

Plating Condition: Constant Potential, - 0.500 V

Filename: 0909

Magnification: 101 X
APPENDIX M

SEM images for C6, C7, C8, C9, C10 and C11

Sample Name: C6

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: H₂SO₄, Glycine

Plating Condition: Constant Current, + 1 mA or

Current Density = 1.32 A/cm²

Filename: 1002

Magnification: 803 X
Sample Name: C7
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H₂SO₄, Glycine
Plating Condition: Constant Current, - 1 mA or
                  Current Density = -1.32 A/cm²
Filename: 1004
Magnification: 100 X
Sample Name: C8
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H₂SO₄, Glycine
Plating Condition: Constant Current, + 3 mA or

Current Density = 3.97 A/cm²

Filename: 1008
Magnification: 798 X
Sample Name: C9

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: H_2SO_4, Glycine

Plating Condition: Constant Current, -3 mA or

\[ \text{Current Density} = -3.97 \text{ A/cm}^2 \]

Filename: 1009

Magnification: 100 X
Sample Name: C10

Working Electrode: Glassy Copper

Reference Electrode: Ag/AgCl

Bath Solution: H$_2$SO$_4$, Glycine

Plating Condition: Constant Current, + 5 mA or

Current Density = 6.22 A/cm$^2$

Filename: 1014

Magnification: 806 X
Sample Name: C11
Working Electrode: Glassy Copper
Reference Electrode: Ag/AgCl
Bath Solution: H₂SO₄, Glycine
Plating Condition: Constant Current, - 5 mA or
          Current Density = -6.22 A/cm²
Filename: 1016
Magnification: 100 X
Operator: derrick
Client: none
Job: Condition 1024, 20keV
(22/05/2000 14:33)
APPENDIX O

Operator: derrick
Client: none
Job: Condition 1024, 20keV
(22/05/2000 15:13)

Counts

Energy (keV)

Si
O
APPENDIX P

Operator: derrick
Client: none
Job: Condition 1024, 20keV
(22/05/2000 15:01)