APPENDIX

Cyclic voltammetry experiments

1. Calculation of the concentration of supporting electrolyte

1.1 Preparation of 0.1 M TEAP

TEAP has molecular weigh = 229.71 g/mol.

In CH_3CN 50 ml, the number of gram of TEAP is

$$= (229.71 \text{ g/mol})\ (0.1 \text{ mol/l})\ (50 \times 10^{-3} \text{ l})$$

$$= 1.140 \text{ g}$$

$\therefore$ Weigh TEAP 1.140 g and dissolve in CH_3CN 50 ml.

1.2 Preparation of 0.1 M TBAP

TBAP has molecular weigh = 387.43 g/mol

In CH_3CN 50 ml, the number of gram of TBAP is

$$= (387.43 \text{ g/mol})\ (0.1 \text{ mol/l})\ (50 \times 10^{-3} \text{ l})$$

$$= 1.9371 \text{ g}$$

$\therefore$ Weigh TEAP 1.9371 g and dissolve in CH_3CN 50 ml.

2. Calculation of the concentration of ketone and quinone compounds

2.1 Preparation of 1.0×10^{-3} M Cyclohexanone in 50 ml CH_3CN

Preparation of Cyclohexanone, the number of volume of Cyclohexanone in CH_3CN 50 ml is

$$= \frac{(1 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})(98.15 \text{ g/mol})}{0.947 \text{ g/ml}}$$

$$= 5.20 \text{ microlite.}$$

2.2 Preparation of 1.0×10^{-3} M *p*-Benzoquinone 50 ml CH_3CN

p-Benzoquinone has molecular weigh = 108.1 g/mol

Preparation of *p*-Benzoquinone 1.0×10^{-3} M, the number of gram of *p*-Benzoquinone in CH_3CN 50 ml $= (108.1 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 5.405$ mg

$\therefore$ Weigh *p*-Benzoquinone 5.405 mg and dissolve in CH_3CN 50 ml which TBAP 1.931 g (0.1M).

2.3 Preparation of 1.0×10^{-3} M Tetrahydroxybenzoquinone in 50 ml CH_3CN

Tetrahydroxy-1,4-benzenequinone F.W = 208.13 g/mol

Preparation of Tetrahydroxy-1,4-benzenequinone 1.0×10^{-3} M, the number of gram of Tetrahydroxy-1,4-benzenequinone in CH_3CN 50 ml is

$= (208.13 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 10.4065$ mg.

$\therefore$ Weigh Tetrahydroxy-1,4-benzenequinone 10.4065 mg and dissolve in CH_3CN 50 ml with TBAP 1.9371 g.

2.4 Preparation of 1.0×10^{-3} M Benzophenone in 50 ml CH_3CN

Benzophenone F.W = 182.2 g/mol

Preparation of benzophenone 1.0×10^{-3} M, the number of gram of Benzophenone in 50 ml CH_3CN $= (182.2 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 9.110$ mg

$\therefore$ Weigh Benzophenone 9.110 mg and dissolve in CH_3CN 50 ml with TBAP 1.9371 g (0.1 M).

2.5 Preparation of 1.0×10^{-3} M α-Tetralone in 50 ml CH_3CN

α-Tetralone F.W. = 146.19 g/mol

Preparation of α-Tetralone 1.0×10^{-3} M, the number of gram of α-Tetralone in 50 ml CH_3CN = (146.19 g/mol)(1.0×10^{-3} mol/l)(50×10^{-3} l)

= 7.3095 mg

From D = m/V

The number of volume of α-Tetralone = $\frac{(7.3095 \text{ mg})}{1.096 \text{ g/ml}}$

= 6.67×10^{-3} ml

2.6 Preparation of 1.0×10^{-3} M 1,4-Naphthoquinone in 50 ml CH_3CN

1,4-Naphthoquinone F.W = 158.0 g/mol

Preparation of 1,4-Naphthoquinone 1.0×10^{-3} M, the number of gram of 1,4-Naphthoquinone in 50 ml CH_3CN is

= (158.2 g/mol)(1.0×10^{-3} mol/l)(50×10^{-3} l)

= 7.908 mg

∴ Weigh 1,4-Naphthoquinone 7.908 mg and dissolve in CH_3CN 50 ml with TBAP 1.931 g (0.1 M).

2.7 Preparation of 1.0×10^{-3} M Anthrone in 50 ml CH_3CN

Anthrone F.W = 194.23 g/mol

Preparation of Anthrone 1.0×10^{-3} M, the number of gram of Anthrone in 10 ml CH_3CN is = (194.23 g/mol)(1.0×10^{-3} mol/l)(50×10^{-3} l)

= 9.711 mg

∴ Weigh Anthrone 9.711 mg and dissolve in CH_3CN 50 ml with TEAP 0.229 g (0.1 M).

2.8 Preparation of 1.0×10^{-3} M 9-Xanthone in 50 ml CH_3CN

9-Xanthone F.W = 196.21 g/mol

Preparation of 9-Xanthone 1.0×10^{-3} M, the number of gram of 9-Xanthone in 10 ml CH_3CN is $= (196.21 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 9.810$ mg

$\therefore$ Weigh 9-Xanthone 9.810 mg and dissolve in CH_3CN 50 ml with TBAP 1.937 g (0.1 M)

2.9 Preparation of 1.0×10^{-3} M Anthraquinone in 50 ml CH_3CN

Anthraquinone F.W = 208.22 g/mol

Preparation of Anthraquinone 1.0×10^{-3} M, the number of gram of Anthraquinone in 50 ml CH_3CN $= (208.22 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 10.411$ mg

$\therefore$ Weigh Anthraquinone 10.411 mg and dissolve in CH_3CN 50 ml with TBAP 1.937 g (0.1 M).

2.10 Preparation of 1.0×10^{-3} M 1,2-Dihydroxyanthraquinone in 50 ml CH_3CN

1,2-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,2-Dihydroxyanthraquinone 1.0×10^{-3} M, the number of gram of 1,2-Dihydroxyanthraquinone in 50 ml CH_3CN is

$= (240.21 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$

$= 12.010$ mg

$\therefore$ Weigh 1,2--Dihydroxyanthraquinone 12.010 mg and dissolve in CH_3CN 50 ml with TBAP 1.937 g (0.1 M).

2.11 Preparation of 1.0×10^{-3} M 1,4-Dihydroxyanthraquinone in 50 ml CH_3CN

1,4-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,4-Dihydroxyanthraquinone 1.0×10^{-3} M, the number of gram of 1,4-Dihydroxyanthraquinone in 10 ml CH_3CN is

$$= (240.21 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$$

$$= 12.010 \text{ mg}$$

$\therefore$ Weigh 1,4-Dihydroxyanthraquinone 12.010 mg and dissolve in CH_3CN 50 ml with TBAP 1.937 g (0.1 M).

2.12 Preparation of 1.0×10^{-3} M 1,8-Dihydroxyanthraquinone in CH_3CN 50 ml

1,8-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,8-Dihydroxyanthraquinone 1.0×10^{-3} M, the number of gram of 1,8-Dihydroxyanthraquinone in 50 ml CH_3CN is

$$= (240.21 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(50 \times 10^{-3} \text{ l})$$

$$= 12.010 \text{ mg}$$

$\therefore$ Weigh 1,8-Dihydroxyanthraquinone 12.010 mg and dissolve in CH_3CN 50 ml with TBAP 1.937 g (0.1 M).

2.13 Preparation of 1.0×10^{-3} M Dammacanthal in 10 ml CH_3CN

Dammacanthal F.W = 294.0 g/mol

Preparation of Dammacanthal 1.0×10^{-3} M, the number of gram of Dammacanthal in10 ml CH_3CN is $= (294.0 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(10 \times 10^{-3} \text{ l})$

$$= 2.940 \text{ mg}$$

$\therefore$ Weigh Dammacanthal 2.940 mg and dissolve in CH_3CN 10 ml with TEAP 0.229 g (0.1 M).

3. Calculation of the concentration of Silver

$AgNO_3$ F.W = 169.87 g/mol.

3.1 Preparation of silver 1.0×10^{-2} M in acetonitrile 50 ml with 0.1 M TEAP

The number of gram of $AgNO_3$ in 50 ml CH_3CN is

$$= (169.87 \text{ g/mol})(1.0 \times 10^{-2} \text{ mol/l})(50 \times 10^{-3} \text{ l})$$

$$= 0.0849 \text{ g}$$

$\therefore$ Weigh $AgNO_3$ 0.0849 g and dissolve in CH_3CN 50 ml with TEAP 1.140 g (0.1 M).

3.2 Preparation of silver 0.1 M in acetonitrile 50 ml

The number of gram of $AgNO_3$ in 50 ml CH_3CN is

$$= (169.87 \text{ g/mol})(0.1 \text{ mol/l})(50 \times 10^{-3} \text{ l}).$$

$$= 0.8494 \text{ g}$$

$\therefore$ Weigh $AgNO_3$ 0.8494 g and dissolve in CH_3CN 50 ml.

3.3 Preparation of silver 1.0×10^{-4} M in acetonitrile 100 ml

The number of gram of $AgNO_3$ in 100 ml CH_3CN is

$$= (169.87 \text{ g/mol})(1.0 \times 10^{-4} \text{ mol/l})(100 \times 10^{-3} \text{ l})$$

$$= 1.699 \text{ mg}$$

$\therefore$ Weigh $AgNO_3$ 1.699 mg and dissolve in CH_3CN 100 ml.

4. UV-Visible experiments

4.1 Calculation of the concentration of ketones

4.1.1 Cyclohexanone 1.0×10^{-2} M in CH_3CN 100 ml

Preparation of Cyclohexanone , the number of volume of Cyclohexanone in CH_3CN 100 ml is

$$= \frac{(1 \times 10^{-2} \text{ mol/l})(100 \times 10^{-3} \text{ l})(98.15 \text{ g/mol})}{0.947 \text{ g/ml}}$$

$$= 103.64 \text{ microlite}$$

4.1.2 *p*-Benzoquinone 1.0×10^{-2} M CH_3CN 100 ml

p-Benzoquinone F.W = 108.1 g/mol

Preparation of *p*-Benzoquinone 1.0×10^{-2} M, the number of gram of *p*-Benzoquinone in CH_3CN 100 ml is $= (108.1 \text{ g/mol})(1.0 \times 10^{-2} \text{ mol/l})(100 \times 10^{-3} \text{ l})$

$$= 0.1081 \text{ g}$$

∴ Weigh *p*-Benzoquinone 0.1081 g and dissolve in CH_3CN 100 ml.

4.1.3 Tetrahydroxy-1,4-benzenequinone (7.0×10^{-5} M) in CH_3CN 100 ml

Tetrahydroxy-1,4-benzenequinone F.W = 208.13 g/mol

Preparation of Tetrahydroxy-1,4-benzenequinone 7.0×10^{-5} M, the number of gram of Tetrahydroxy-1,4-benzenequinone in CH_3CN 100 ml is

$$= (208.13 \text{ g/mol})(7.0 \times 10^{-5} \text{ mol/l})(100 \times 10^{-3} \text{ l})$$

$$= 1.456 \text{ mg}$$

∴ Weigh Tetrahydroxy-1,4-benzoquinone 1.456 mg and dissolve in CH_3CN 100 ml.

4.1.4 Benzophenone (2.0×10^{-5} M) in CH_3CN 100 ml.

Benzophenone F.W = 182.2 g/mol

Preparation of Benzophenone 2.0×10^{-5} M, the number of gram of Benzophenone in 100 ml CH_3CN is = (182.2 g/mol)(2.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.3644 mg

$\therefore$ Weigh benzophenone 0.3644 mg and dissolve in CH_3CN 100 ml.

4.1.5 α-Tetralone (3.0×10^{-5} M) in CH_3CN 100 ml

α-Tetralone F.W. = 146.19 g/mol

Preparation of α-Tetralone 3.0×10^{-5} M, the number of gram of α-Tetralone in 100 ml CH_3CN is

= (146.19 g/mol)(3.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.4386 mg

From D = m/V

The number of volume of α-Tetralone = $\frac{(0.4386 \text{ mg})}{1.096 \text{ g/ml}}$

= 400.18 microlite.

4.1.6 1,4-Naphthoquinone (5.0×10^{-5} M) in CH_3CN 100 ml

1,4-Naphthoquinone F.W = 158.2 g/mol

Preparation of 1,4-Naphthoquinone 5.0×10^{-5} M, the number of gram of 1,4-Naphthoquinone in 100 ml CH_3CN is

= (158.2 g/mol)(5.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.791 mg

$\therefore$ Weigh 1,4-Naphthoquinone 0.791 mg and dissolve in CH_3CN 100 ml.

4.1.7 Anthrone (1.0×10^{-5} M) in CH_3CN 100 ml

Anthrone F.W = 194.23 g/mol

Preparation of Anthrone 1.0×10^{-5} M, the number of gram of Anthrone in 100 ml CH_3CN is = (194.23 g/mol)(1.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.1942 mg

∴ Weigh Anthrone 0.1942 mg and dissolve in CH_3CN 100 ml.

4.1.8 Xanthone (2.0×10^{-5} M) in CH_3CN 100 ml

Xanthone F.W = 196.21 g/mol

Preparation of 9-Xanthone 2.0×10^{-5} M, the number of gram of 9-Xanthone in 100 ml CH_3CN is = (196.21 g/mol)(2.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.3924 mg

∴ Weigh 9-Xanthone 0.3924 mg and dissolve in CH_3CN 100 ml.

1.4.9 Anthraquinone (9.0×10^{-6} M) in CH_3CN 100 ml

Anthraquinone F.W = 208.22 g/mol

Preparation of Anthraquinone 9.0×10^{-6} M, the number of gram of Anthraquinone in 100 ml CH_3CN is = (208.22 g/mol)(9.0×10^{-6} mol/l)(100×10^{-3} l).

= 0.1874 mg.

∴ Weigh Anthraquinone 0.1874 mg and dissolve in CH_3CN 100 ml.

1.4.10 1,2-Dihydroxyanthraquinone (4.0×10^{-5}M) in CH_3CN 100 ml

1,2-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,2-Dihydroxyanthraquinone 4.0×10^{-5} M, the number of gram of 1,2-Dihydroxyanthraquinone in 100 ml CH_3CN is

= (240.21 g/mol)(4.0×10^{-5} mol/l)(100×10^{-3} l)

= 0.9608 mg.

∴ Weigh 1,2-Dihydroxyanthraquinone 0.9608 mg and dissolve in CH_3CN 100 ml.

4.1.11 1,4-Dihydroxyanthraquinone (1.0×10^{-5} M) in CH_3CN 100 ml

1,4-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,4-Dihydroxyanthraquinone 1.0×10^{-5} M, the number of gram of 1,4-Dihydroxyanthraquinone in 100 ml CH_3CN is

$= (240.21 \text{ g/mol})(1.0 \times 10^{-5} \text{ mol/l})(100 \times 10^{-3} \text{ l})$

$= 0.2402$ mg

∴ Weigh 1,4-Dihydroxyanthraquinone 0.2402 mg and dissolve in CH_3CN 100 ml.

4.1.12 1,8-Dihydroxyanthraquinone (1.0×10^{-5} M) in CH_3CN 100 ml

1,8-Dihydroxyanthraquinone F.W = 240.21 g/mol

Preparation of 1,8-Dihydroxyanthraquinone 1.0×10^{-5} M, the number of gram of 1,8-Dihydroxyanthraquinone in 100 ml CH_3CN is

$= (240.21 \text{ g/mol})(1.0 \times 10^{-5} \text{ mol/l})(100 \times 10^{-3} \text{ l})$

$= 0.2402$ mg.

∴ Weigh 1,8-Dihydroxyanthraquinone 0.2402 mg and dissolve in CH_3CN 100 ml.

4.1.13 Dammacanthal (2.0×10^{-5} M) in CH_3CN 100 ml

Dammacanthal F.W = 294.0 g/mol

Preparation of Dammacanthal 2.0×10^{-5} M, the number of gram of Dammacanthal in 25 ml CH_3CN

$= (294.0 \text{ g/mol})(2.0 \times 10^{-5} \text{ mol/l})(100 \times 10^{-3} \text{ l})$

$= 0.5880$ mg

$\therefore$ Weigh Dammacanthal 0.5880 mg and dissolve in CH_3CN 100 ml

5. The chemically modified carbon paste electrode experiments

5.1 Preparation of HNO_3 0.2 M

M.W. of HNO_3 is equal to 63.01 g/mol

Preparation of HNO_3 0.2 M in distill water 500 ml, the number of gram of HNO_3 in 500 ml distill water is $= (63.01 \text{ g/mol})(0.2 \text{ mol/l})(500 \times 10^{-3} \text{ l})$

$= 6.301$ g

But it was prepared from HNO_3 65% w/w

Calculation of HNO_3 65% w/w is

HNO_3 65 g in solution 100 g

HNO_3 6.301 g in solution $= (100 \text{ g} \times 6.301 \text{ g})/(65 \text{ g})$

$= 9.693$ g

From $D = m/V$

$V = (9.693 \text{ g})/(1.42 \text{ g/ml})$

$= 6.83$ ml

So HNO_3 0.2 M was prepared by pipett 6.83 ml of HNO_3 65% w/w mixed with distill water 500 ml.

5.2 Preparation of 1.0×10^{-3} M silver ion in HNO_3 0.2 M

Preparation of Silver 1.0×10^{-3} M in 500 ml of 0.2 M HNO_3, the number of gram of $AgNO_3$ in 500 ml of 0.2 M HNO_3 is

$= (169.87 \text{ g/mol})(1.0 \times 10^{-3} \text{ mol/l})(500 \times 10^{-3} \text{ l})$

$= 0.0849$ g

$\therefore$ Weigh $AgNO_3$ 0.0849 g and dissolve in 500 ml of 0.2 M HNO_3.

PRESENTATION OF THIS THESIS

1. This research was poster presented by Mr. Chanwit Photicunapat. In the topic of the electrochemical behavior of some ketone and quinone compounds in 55th Annual Meeting of the International Society of Electrochemistry, 19-24 September 2004, THESSALONIKI, GREECE.

2. This work was orally presented by Mr. Chanwit Photicunapat in The Postgrduate Education and Research Program in Chemistry Congress III, 9-12 May 2004, Jomtien Palm Beach Resort Pattaya, Chonburi, Thailand.

3. It was orally presented in The 2nd PSU Symposium on Graduate Research Conference, 12 March 2004, Graduate School, Prince of Songkla University, Thailand which presented by Mr. Chanwit Photicunapat.

4. The presentation about electrochemistry of 29th Congress on Science and Technology of Thailand, 20-22 October 2003, Golden Jubilee ConventionHall, Khon Kean University, Thailand which was poster presented by Mr. Chanwit Photicunapat. In the topic of the electrochemical behavior of some aromatic ketone compounds and their application to silver ion analysis.

5. The poster presentation of 30th Congress on Science and Technology of Thailand during 19-21 October 2004 at Impact Exhibition and Convention Center, Muang Thong Thani, Bangkok, Thailand which was poster presented by Mr. Chanwit Photicunapat. In the topic of the electrochemical behavior of some ketone and quinone compounds and their application to silver analysis.