LIST OF FIGURES

	I	Page
Figure 1.1	Schematic diagram showing an principle of electroplating process	6
Figure 1.2	Units cells of the three most importance lattices	10
Figure 2.1	Steel plate cathode	19
Figure 2.2	Electroplating experiment set-up	21
Figure 2.3	Schematic for an Electrodeposition experiment	21
Figure 2.4	Cyclic voltammetry experiment set up	26
Figure 2.5	3 electrode cell, A: Counter Electrode, B: Reference Electrode, C: Working Electrode	27
Figure 2.6	Structure of counter electrode – Platinum wire	27
Figure 2.7	Structure of saturated calomel electrode SCE	27
Figure 2.8	Schematic of WonATech WMPG5000	28
Figure 2.9	Schematic representation of a crystalline lattice. The arrow indicates directions of the incident and reflected X-Ray beams	29
Figure 2.10	Schematic of XRD instrument	30
Figure 2.11	Schematic of SEM-FEI Quanta 250 FEG	32
Figure 2.12	Schematic of Autolab PGSTAT-302N	33
Figure 3.1	Electrodeposits sample at different current densities	36
Figure 3.2	The mass deposition of Cu-Pb alloy at different current densities in MSA bath for 45 min	38
Figure 3.3	Variation of current efficiency with deposition current density	41
Figure 3.4	X-ray diffraction pattern before electroplating and electrodeposited Cu-Pb alloy on steel substrate obtained from range of 4 mA cm ^{-2} to 18 mA cm ^{-2}	46 - 49
Figure 3.5	SEM micrograph of uncoated steel at different magnifications (a) 500, (b) 1000, (c) 2500 and (d) 5000 times , together with the EDX spectrum.	53
Figure 3.6	SEM Micrographs (magnification 500 times) of Cu-Pb alloy electrodeposited from MSA aqueous solution at different current densities for 45 min.	54

- Figure 3.7 SEM Micrographs (magnification 1,000 times) of Cu-Pb alloy 55 electrodeposited from MSA aqueous solution at a different current densities for 45 min
- Figure 3.8 SEM micrographs (magnification 2,500 times) of Cu-Pb alloy 56 electrodeposited from MSA aqueous solution at a different current densities for 45 min
- Figure 3.9 SEM micrographs (magnification 5,000 times) of Cu-Pb alloy 57 electrodeposited from MSA aqueous solution at a different current densities for 45 min
- Figure 3.10 EDX spectrum to show the composition of electrodeposited Cu-Pb 58 layer at different current density.
- Figure 3.11 EDX result of the percentage of elements in Cu-Pb alloy 59 electrodeposited from MSA electrolyte at different current densities
- Figure 3.12 Cyclic voltammograms for steel substrate in the solution of 0.1 mol dm⁻³ Cu²⁺ + 1 mol dm⁻³ MSA. The electrodes were not stirred and the scan rate was 25 mV s⁻¹.
 (A) Negative potential, (B) Positive potential
- Figure 3.13 Show the cyclic voltammogram recorded for steel electrode in 0.3 $64 \text{ mol dm}^{-3} \text{ Pb}^{2+} + 1 \text{ mol dm}^{-3} \text{ MSA}$ with the scan rate of 25 mV s⁻¹.
- Figure 3.14 Cyclic voltammetry of copper-lead alloy on steel substrate from an 64 electrolyte composed of 0.1 mol dm⁻³ Cu(OOCCH₃)₂,0.3 mol dm⁻³ Pb(OOCCH₃)₂ and 1.0 mol dm⁻³ methanesulfonic acid. The electrode were not stirred and the scan rate was 25 mV s⁻¹
- Figure 3.15 Cyclic Voltammograms of a glassy carbon electrode in solution of 65 $0.02 \text{ mol dm}^{-3} \text{ Cu}^{2+} + 2 \text{ mol dm}^{-3} \text{ MSA}$, potential sweep rate at 25 mVs⁻¹
- Figure 3.16 Cyclic Voltammograms of a glassy carbon electrode in solution of 65 $0.01 \text{ mol dm}^{-3} \text{ Pb}^{2+} + 2 \text{ mol dm}^{-3} \text{ MSA}$, potential sweep rate at 25 mVs^{-1}