AUTOMATED ELECTROPLATING DEVICE COUPLED WITH A COLORIMETER TO MAINTAIN ELECTROPLATING VOLTAGE

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Electroplating is a chemical process of forming a protective coating of one metal upon another. In this study, a thin layer of a different metal is plated on another to get some desired properties. Normal Electroplating cell consists of four parts; Anode, Cathode, Electrolyte solution and the external direct current (dc) power supply. There are two types of electroplating; the consumable anode system and the non-consumable anode system. In the consumable anode system**,** the anode gets corroded during the electroplating process and the current density across the anode and cathode gets changed. In non-consumable anode systems, the ions in the solution are deposited on the cathode and the concentration decreases during the plating process. Therefore, the electroplating solution should be replenished frequently for the continuity of the plating process. Galvenostat and Potentiostat systems are used to maintain fixed current through an analyte solution and a fixed voltage across the electrodes in electroplating, respectively.

The constructed device consisted of an electroplating device with transparent cell, colorimeter, voltage amplifier, data processing unit and voltage driver circuit. The concentration variation of the electroplating solution could be linearly detected by the colorimeter while the other components in this device decide the electroplating voltage according to the present concentration of the electrolyte solution and the desired condition of the electroplating. This desired condition (e.g. electroplating voltage and concentration of the solution) is governed by the program written in the data processing unit and accordingly**,** the electrode voltage is automatically adjusted and driven by the voltage driver circuit**.** Therefore, the plating process is continued in a desired condition even though the concentration of the solution gets reduced. $CuSO_4$ as the electrolyte solution, carbon-rod as the anode and an aluminium-plate as the cathode were used to demonstrate the working principle of the constructed device.

The following equation can be obtained for the concentration of electrolyte solution using Beer-Lambert's Law.

$$C = k\ \{-\log[V/V_o]\}$$

Where, C is the concentration of the analyte solution, V is the output voltage of the colorimeter and V_0 is the corresponding voltage to the blank solution. k is the concentration - voltage proportionality constant which depends on the properties of incident radiation as well as the solution. This constant was predetermined using a series of electrolyte solution with different concentrations. According to the results**,** the colorimeter device produced a linear relationship between the concentration of the solution and the absorbance defined in Beer-Lambert's Law.

The software decides the electroplating voltage according to the concentration of the electrolyte solution. For simplicity, it is assumed that, to maintain a uniform electroplating, the electroplating voltage (V_e) is inversely proportional to the concentration of the electrolyte solution. It is mathematically given by $V_e \alpha 1/C$, then $V_e = K_e(1/C)$ where, K_e is an experimental constant for a specific system. In this system, any complicated relationship between the concentration of the electrolyte solution and electroplating voltage can be managed by modifying the program according to the desired condition in electroplating. This system is more important for an electroplating system in which the concentration of the solution is changed rapidly. Therefore, this is a suitable solution for the replenishment problem of the non-consumable anode system.

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