

## **AN INEXPENSIVE GEL ELECTROPHORESIS SYSTEM USING GOLD ELECTRODES**

S. D. Wimalachandra<sup>\*</sup>, C. A. N. Fernando

*Department of Electronics, Wayamba University of Sri Lanka, Kuliyaipitiya, Sri Lanka*

*sajid.wimalachandra@ymail.com*

### **ABSTRACT**

A method used in clinical and research laboratories for separating molecules according to their size and electrical charge is called electrophoresis. Many types of electrophoresis systems are used in the world. However this project is based on agarose gel electrophoresis. In gel electrophoresis an electric current is passed through an agarose gel that contains the mixture of molecules. Each kind of molecule travels through the medium at a different rate, depending on its electrical charge and molecular size. Separation of the molecules occurs based on these differences. The purpose of this research project is to reduce the cost of this unit considering the electrode type. Because generally, Platinum electrodes are used as electrodes of this system. But when considering the cost of Platinum, it is comparatively very high. Hence gold plated electrodes and gold electrodes were selected such as substitutional electrodes for Platinum. Then the gold electrodes were most suitable electrodes for this system because electrical characteristics and chemical characteristics were similar to the platinum electrodes but the cost of gold is less than platinum. Further as an additional part of this project is preparing electrophoresis power supply for this system. As an output voltage of power supply is obtained 55V because of this voltage depends on the distance between electrodes. And the gel tank also prepared as a desired dimension.

**Keywords:** Gel Electrophoresis, Electrodes, Buffer, Power supply

### **1. INTRODUCTION**

Gel electrophoresis is the technique which is used to separate molecules such as Deoxy ribose nucleic acid (DNA), ribose nucleic acid (RNA) and protein based on their size and electrical charge. This is an electrochemical process. The main parts of this system are gel tank, gel tray and electrodes. Platinum electrodes are used as electrodes in this system. But the cost of this electrode type is very high. Therefore, in this research, chemical and electrical

characteristics of platinum electrodes were compared with selected electrodes types. Then Gold plated electrodes and Gold electrodes were used as electrodes for this gel electrophoresis system.

Further gel electrophoresis power supply was prepared as an additional part of this system. The required power was decided according to distance between electrodes. It was 5V / 1 cm.

Finally this project was prepared a low cost gel electrophoresis system with combining power supply.

## **2. EXPERIMENTAL**

### **2.1 Preparing simple gel electrophoresis tank**

When designing gel electrophoresis system, firstly the dimensions of the system should be identified according to previous designing. Then the 2D view of gel tank with cap and gel tray were designed using auto cad.

After designing gel tank, Perspex was selected as the material which is most suitable for gel tank. Because of, it is hard and tenable material. Then preparing systems was decided. Drilling machine, hot air gun, Perspex cutters was used as tools for preparing this tank. Chloroform chemical was used as adhesive material, because chloroform was melted Perspex. Then the banana plugs were connected to the box for connecting electrodes.

### **2.2 Testing most suitable cost effective electrodes type**

The properties of mercury, carbon, silver and gold was compared in theoretically. Then gold was selected as the suitable electrode than others.

Firstly plated gold was used as a cathode of the gel electrophoresis system. Then it was corroded. Thus it was used as anode of this system. Finally plated gold electrode was used as both of anode and cathode.

Then gold metal was selected as an electrodes of this system. It is also used as only an anode and only a cathode.

### **2.3 Designing gel electrophoresis power supply**

Main parts of the power supply was identified.

Then the required values of the components were decided and the circuit was designed using Proteus software. After simulation, the circuit was prepared.

### 3. RESULTS AND DISCUSSION

When comparing the properties of gold and platinum it can be discussed as follows. When both metals are treated in the same way, platinum gives equilibrium exchange current densities approx. 10 times higher than gold, both in aerated activated sludge and in treated water. For platinum, the equilibrium exchange current densities range from 0.1 to 0.25  $\mu\text{A}/\text{cm}^2$  immediately after polishing and decrease during prolonged contact with activated sludge subjected to alternating aeration/anoxia sequences.

The lower kinetics of electron transfer on gold go together with significant differences in response.

In an aerobic medium a gold electrode potential is lower than that of a platinum electrode. In a strongly anaerobic medium, the reverse is true. Consequently, the amplitude of the potential variation between aerobic and anaerobic media is smaller for gold than for platinum. Under our experimental conditions this amplitude was approx 350 mV for gold and 850 mV for platinum.

The slopes of the linear relationships between potential and pH or potential and the logarithm of the dissolved oxygen concentration are two or three times greater for platinum than for gold.

Although the values obtained with platinum electrodes cannot represent a veritable equilibrium state, the platinum electrode zero-current potential would seem to be far more sensitive to variations in the medium than that of the gold electrode; it is, therefore, more suitable for use in activated sludge<sup>3</sup>.

In this research, firstly plated gold was used as a cathode of the gel electrophoresis system. Then it was corroded. Thus it was used as anode of this system. Finally plated gold electrode was used as both of anode and cathode. The results was occurred as following figure 1.:

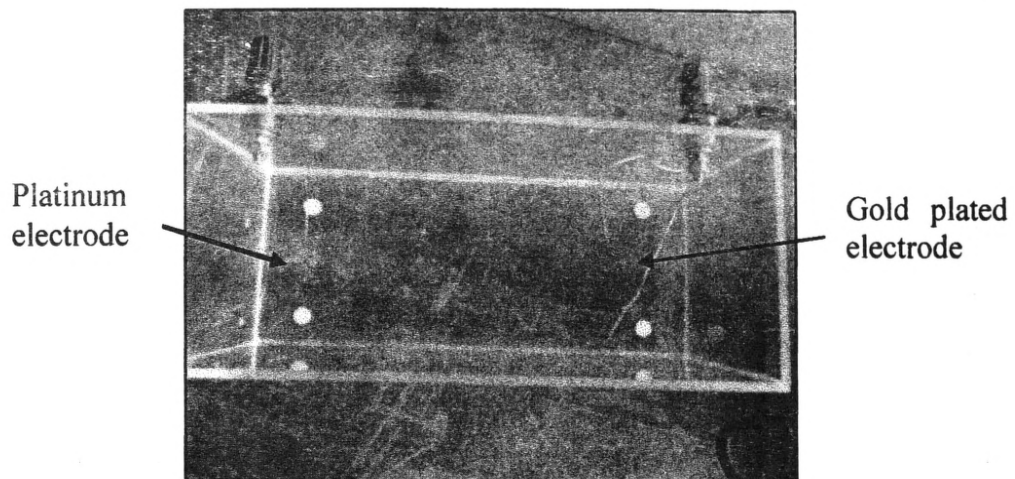


Figure 1: Electrolyzing using Platinum electrodes and plated Gold electrodes

Due to this result, plated gold was not suitable as an electrode of gel electrophoresis system. Hence gold metal was selected as an electrodes of this system. It is also used as only an

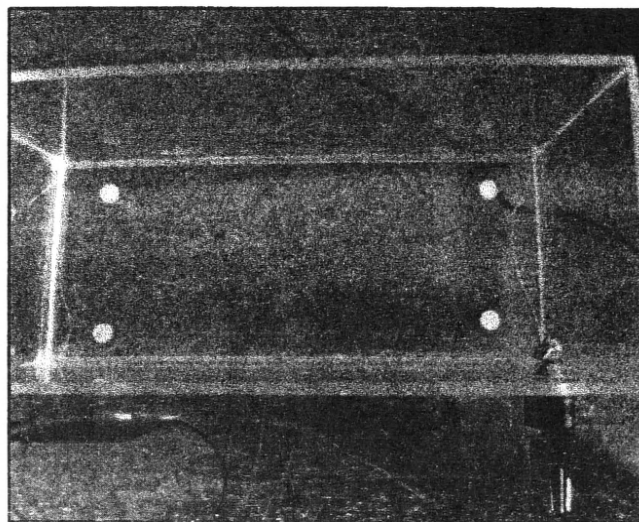


Figure 2: Platinum and gold electrodes

anode and only a cathode. It was tested as follows,

When use gold metal as electrode, it was not corroded.

Finally as a results of this experiment was, the result of plated gold electrode was corroded in the electrolyzing and gold electrode wasn't corroded.

In 2014, a group of scientists found Nicrom doesn't corrode at the cathode side of the electrophoresis system. It can be used in one side only the other side should be used platinum, but in this research, gold electrodes are not corrode both anode and cathode sides.

The price of gel electrophoresis system in the world market is \$500 (Rs.71990), but the total cost of this gel electrophoresis system was less than \$34 (Rs.5000). Therefore this project main purpose is reducing cost of this system was fulfilled.

#### **4. CONCLUSION**

The conclusion of this project is gold can be used as electrodes in gel electrophoresis system. Due to the properties of gold are similar to the platinum electrodes. The total cost of this system was 5000 rupees, but in market, the price of this system is 100000 rupees. Due to the result of this research can be reduce the cost of the system.

#### **AKNOWLEDGEMENTS**

Authors would like to convey their gratitude to the staff of Department of Electronics, Faculty of Applied Sciences, Wayamba University of Sri Lanka.

#### **REFERENCES**

- [1] <http://www.biologyreference.com/Dn-Ep/Electrophoresis.html> [1].
- [2] Jack G. Chirikjian ,*Biotechnology: Genetic engineering, mutagenesis, separation technology*, Jones & Bartlett Learning, 1995[2].
- [3] <http://www.medicinenet.com/script/main/art.asp?articlekey=3218> [3]

