Morphological and Electrical Characterization of 130nm Interdigitated Electrode (IDE)

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***Abstract*— Biosensor is the application of sensor that widely applied and still progressing until today. One of the applications of biosensor is Interdigitated Electrode (IDE) that composed of finger of electrodes and a pair of pad. Nanogap is the gap between the electrodes that can determine the sensitivity of the device. In this experiment, 130nm of IDE is tested with the electrical measurement and showed the positive result which is 2.0×10^{-10} at 0.2 V. The Scanning Electron Microscopy (SEM) of the device showed the small gap is used for better sensitivity without deposite anything on the probe. In the future, this IDE can be used for coating with metal oxides for better performance of the device.**

Keywords— ***Interdigitated Electrode (IDE), Electrode Gap, Electrical Measurement (I-V), Scanning Electron Microscopic (SEM).***

I. INTRODUCTION

Interdigitated Electrode (IDE) is currently installed in many sensing devices such as surface acoustic waves (SAW) sensors, chemical sensors and recently Micro-electrical Systems or known as MEMs biosensors. IDE is consists of electrode pads and electrode fingers that carefully designed considering the area, bandwidth and the gap between the electrode fingers to give the output for signal strength [1]. IDE is developed to be more sensitive as the distance between the finger electrodes is minimized for capacitive detection. IDEs is functioning to detect the electric signals generated by the sensing material [2]. IDE is made as multiple electrode configurations for increasing sensitivity as well as minimizing interferences [3].

II. MATERIALS AND METHODS

A. Photolithography Process

The making of IDE is through fabrication method of photolithography process. Photolithography processes additionally involving complex steps of processing material including photoresist and etching solution conditions [4].

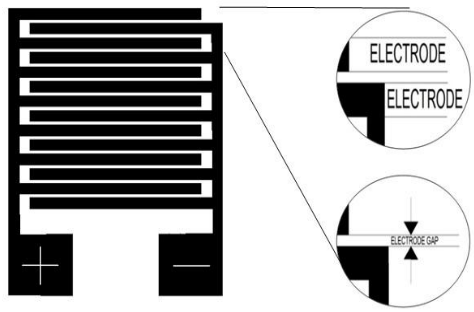

Fig. 1. The illustration of electrode and electrode gap of IDE device

B. Electrode Gap

The key point of this experiment lay on the nanogap (figure 1) of the IDE which is as small as 0.130 μm (130nm) which can generate geometric parameter of the strength of the electric field and the current density compared than width and height of the IDEs [5].

C. Current-Voltage Relationship

V stands for voltage value meanwhile *R* is resistance and *I* is the value of current applied. The final reading of the measurement is set at 1 V with step (V) is 0.1 which means the reading started at 0.1 V made the overall points of reading is 11 times.

III. RESULTS AND DISCUSSION

A. Electrical (I-V) Measurement

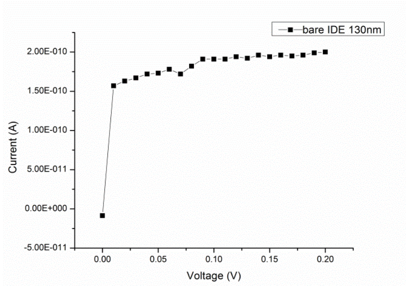

Fig. 2. Electrical measurement (I-V) for bare 130nm IDE for 0.2 V

Figure 2 showed the current-voltage (I-V) measured of IDE within the electrode gap of 130nm with stability achieved at 0.2 V. The stability achieved at 0.2 volt is 2.0×10^{-10}. As shown in the figures the reading of I-V measurement changes with the limited voltage pressurized on the device.

B. Scanning Electron Microscope (SEM)

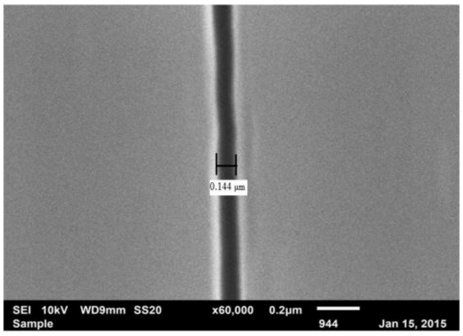

Fig. 3. Scanning Electron Microscopy (SEM) 60KX for magnified under lenses of top view IDE

Figure 3 showed SEM image of cross-section for 130nm IDE device. As clearly showed the gap between two electrodes is 0.144µm which is 144 nm. The gap becomes bigger because of the effect of aluminium (Al) etching during fabrication photolithography process.

IV. CONCLUSIONS

This experimental works is performed to test the functionality of the IDE device that composed of very small gap of electrodes which is 130nm. The device also gave the positive electrical result by showing the reading at different voltage is pressurized on the device. Thus, this device is functionalized accordingly with the size of gap and hopefully the smaller gap is used for better sensitivity of the device even in a very low concentration of detection

REFERENCES

[1] Jr, F.A., Price, D.T., Bhansali, S., Florida, S., n.d. Optimization of Interdigitated Electrode (IDE) Arrays for Impedance Based Evaluation of Hs 578T Cancer Cells.

[2] Pigeon, S., Meunier, M., Sawan, M., Martel, S., 2003. D Esign and F Abrication of a M Icroelectrode a Rray 2, 1–4.

[3] Daniel, D., Gutz, I.G.R., 2005. Microfluidic cells with interdigitated array gold electrodes: Fabrication and electrochemical characterization. Talanta 68, 429–436.

[4] Tseng, C.C., Chou, Y.H., Hsieh, T.W., Wang, M.W., Shu, Y.Y., Ger, M. Der, 2012. Interdigitated electrode fabricated by integration of ink-jet printing with electroless plating and its application in gas sensor. Colloids Surfaces A Physicochem. Eng. Asp. 402, 45–52.

[5] Singh, K. V., Bhura, D.K., Nandamuri, G., Whited, A.M., Evans, D., King, J., Solanki, R., 2011. Nanoparticle-enhanced sensitivity of a nanogap-interdigitated electrode array impedimetric biosensor. Langmuir 27, 13931–13939.