CHAPTER VI
CONCLUSIONS

The measurements of the devices under test and discussion were presented in this chapter. At the end of the chapter, the final conclusion of this study was drawn.

1. Conclusions

The major objective of this research study is to investigate the possibilities of using P-MOSFET and P-I-N diode (products from TMEC, Thailand) as a radiation sensor in radiation dosimetry; and to study the working conditions and effect of device's structure upon the sensitivity of the devices.

The major conclusions drawn from this work are:

1. Radiation dose can induce the threshold voltage shift of P-MOSFET and the breakdown voltage shift of P-I-N Diode. Therefore, both devices have a potential to develop the devices to use as a radiation sensor.

2. Transport temperature plays an important role in the V_T shift of P-MOSFET and V_B shift of P-I-N diodes.

3. The sensitivity of P-MOSFET and PIN diode under test are:

Table 5 Sensitivity of P-MOSFET and PIN diode

Technology	Detail	Sensitivity (mV/cGy)	
		Transport Temperature 15 °C	Transport Temperature 25 °C
P-MOSFET	W/L= 40/40	1.5	N/A
PIN Diode	Square Shape	25	15
	Circle Shape	4	5

4. The sensitivity of RADFET (commercial product) is:

Table 6 Sensitivity of RADFET

Technology	Sensitivity (mV/cGy)
RADFET (commercial product)	1

The radiation sensitivities are plotted in figure 51.

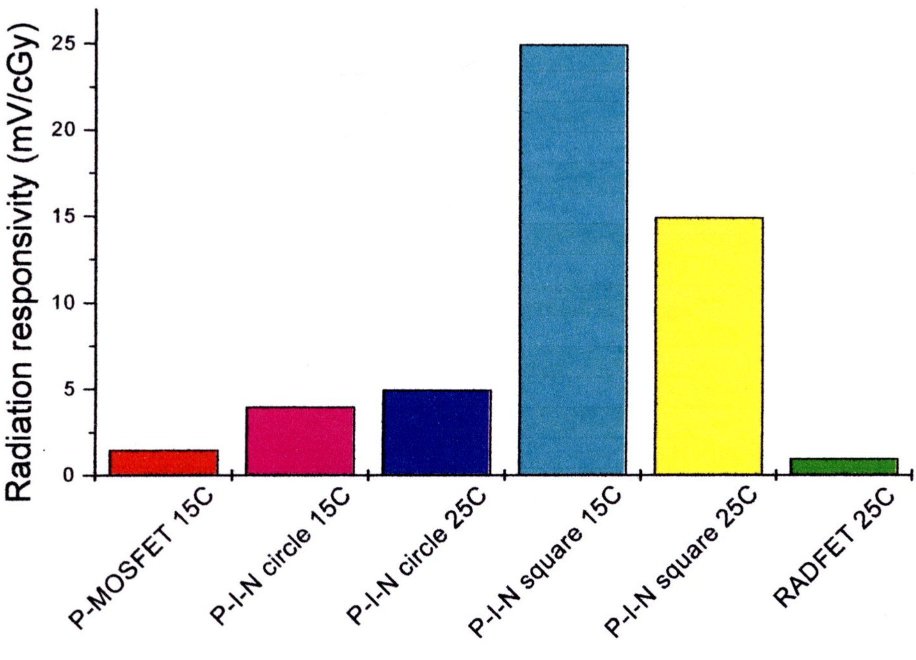

Figure 51 Radiation responsivity of P-MOSFET W/L 40/40, PIN diode (circle and square shape), and RADFET

5. P-MOSFET W/L 40/40 has a higher tolerance to radiation dose than P-MOSFET W/L 40/1.0.

6. The devices under test of this work were given a radiation range of 0 – 2,000 cGy, although the radiation dose normally used for a treatment is 0 – 200 cGy/day. In order to compare and focus the results of the devices under test within a treatment radiation dose, the responsivity of both devices were replotted and zoom in to the range of 0-1000 cGy. The results of PIN diode (figure 49 – 50) present better

linearity than a responsivity of PMOS. This statement is not solid because the results from PIN diodes are from just only two measurements hence it is linear. The further study of the linearity of the PIN diode used as a radiation sensor should be investigated in the future by taking more measurement especially in the range of 0-1000 cGy.

7. The cost of P-MOSFET, PIN diode under test, and RADFET (commercial product) are:

Table 7 Cost of P-MOSFET, PIN diode, and RADFET

Technology	Cost per each device (Baht)
P-MOSFET (not exceed 1,000 cGy)	2,000,000/18,880 ≈ 106
PIN diode (not exceed 2,000 cGy)	50,000/1,888 ≈ 27
RADFET (not exceed 20,000 cGy)	6,500

Cost per each device = wafer cost / amount of device

Amount of device = wafer area / device area

2. Suggestions and future works

2.1 The radiation responsivity of P-MOSFETs and P-I-N diodes do not show a strong potential as a commercial product with high linearity, because this research study has been conducted with very few samples with acceptable quantity to investigate in this study. The further investigation and better research work can be provided if the higher number of samples with good reliable devices is taken during measurements.

2.2 This research only launched a pioneer view on the potential of exploiting the current semiconductor process at TMEC to make a radiation sensor. The results show a possibility to use both devices as a radiation sensor; however, further study on device structure design specifically on improving the profile to suit this particular application, physics-based analytical model has to be carefully studied in order to optimize the device structures. This work must be carried with a good co-operation with physics department or a person who has a strong background in physics then the final target of domestic radiation sensor can be reached.