CHAPTER I
INTRODUCTION

1. Rationale and Background

Verifying the accuracy of radiation dose given to patient has been an acute process for a radiation treatment. Instruments used to verify the above problems are thermoluminescent dosimeter, diode dosimeter; and radiation sensitive field effect transistor (RADFET) dosimeter, etc.

Semiconductor diode detectors became practically available in the early 1960s. Early versions were called crystal counters, but modern detectors are referred to as semiconductor diode detectors or simply solid-state detectors. Diode detectors are based on electron-hole pair collection from semiconductor media (Knoll, 1989). In addition, the advantages of diode detectors are compact sizes, relatively fast timing. Drawbacks may include the limitation to small size, the relatively high susceptibility of these devices to performance degradation from radiation-induced damage, and can not use in off-line measurement (Knoll, 1989; Khan, 1994; Nakamura, Okamoto, 1995).

Apart from diode detectors, there is another interesting candidate used for medical applications, RADFET. The RADFET system – a dosimetric method using MOSFET was first conceived by Poch and Holmes- Siedle in 1969. REM published full details of it almost 32 years ago (Siedle, Adams, 1974). Advantages of RADFETs over other devices are its real time signal, small size, low of power consumption, and potential low cost due to its solid-state implementation (Ristic et al., 1996). The disadvantage of RADFET is a recovery of threshold voltage during an annealing phase after irradiation so called fading process. This has been a major drawback of RADFET operation, and investigated for various types and processes of P-MOS dosimeters (Ristic et al., 1997; Jaksic et al., 2002; Knoll, 1989; Khan, 1994).

Both devices have already been fabricated aboard and applied for local medical treatment; despite its cost. Therefore, this work will launch a pioneer exploration on the possibility of diode dosimeter and RADFET domestically made by a microelectronic foundry in Thailand, Thai Microelectronic Center (TMEC). It aims to exploit the present diode and MOSFET process running at TMEC in order to study the potential of fabricating diode dosimeter and RADFET in mass scale production; hence lowering the cost of diode dosimeter and RADFET devices using for medical uses. The contribution is to develop the knowledge in diode dosimeter and RADFET technology and to produce an expert in this field. The objectives are a thorough study of diode dosimeter and RADFET made by TMEC and compare its radiation responsivity between those two with a commercial product.

2. Objectives

2.1 Investigating a possibility of using P-MOSFET and P-I-N diode made by TMEC as a sensor for a radiation treatment.

2.2 Develop the knowledge of semiconductor dosimeter technology in Thailand

3. Research boundary

3.1 Studying parameters of MOSFET and diode (P-MOSFET and P-I-N diode, products from TMEC, Thailand) only

3.2 Studying the responsivity of

- MOSFET 25 nm gate oxide thickness with W/L ratio 40/1.0, and 40/40
- P-I-N diode with anode circle and square shape

3.3 Irradiate x-ray 6MV with dose range 100 to 10,000 cGy given to devices under test

3.4 Irradiation bias voltage varied from 0V to 10V for MOSFET. Forward bias varies from 0V to 1.3V and reverse bias varies from 0V to 1,000V for PIN diode

3.5 Transport temperature varied from 15°C to 25°C for both cases, and transport time not exceeded 6 hours

4. Anticipated outcomes

4.1 Possibility of a dosimeter either PIN diode or MOSFET made by TMEC, Thailand

4.2 Reduce cost of RADFET and diode dosimeter in mass production