THE ASSESSMENT OF TAILOR-MADE OPTICAL FIBRE SUBJECTED TO IONIZING RADIATION

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I dedicate this work

To my lovely dear parents
Che Omar Bin Ibrahim
Siti Eshah Binti Che Mat
Whose love, kindness, patience and prayer have brought me this far

To my siblings
Siti Nur Hadis and Khairul Anuar, Muhammad Tasyriq and Nur Syuhani, Siti Shafiyyah, Muhammad Askari, Siti Nur Salwah and Muhammad Ali Fariddatul
For their love, understanding and support through my endeavor

To my grandparents
Ibrahim Ariffin and Siti Rahmah
Whose always prayer for me

To my niece
Nur Qurratulain Zahraa, Nur Shiana Asyiqin and Fatimah
Whose presence fills my life with joy

To my friends
For their endless laughs and tears
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ABSTRACT

The dosimetric properties of thermoluminescence (TL) dosimeter such as dose response, linearity, sensitivity, fading, minimum detectable dose (MDD), glow curve and reproducibility of optical fibres in comparison with TLD-100 (rod types) have been investigated. The samples used were Dummy Flat Fibre (DFF), Flat Fibre (FF), Photonic Crystal Fibre (PCF), Multi Photonic Crystal Fibre (MPCF) of 2 mm and 220 µm diameter, Photosensitive Flat Fibre (PFF), Single Mode Optical Fibre (SMF), Germanium - doped (Ge), Erbium - doped (Er) and Aluminum doped Thulium (Al: Tm). The TL samples were placed in solid phantom and irradiated with 6, 9 and 12 MeV electrons beam with dose ranging from 1.0 Gy to 4.0 Gy by using linear accelerator (LINAC) machine. Investigations were also conducted for X - rays with mean energies of 30, 60 and 70 kV, and gamma rays (^{60}Co) from 1.0 mGy up to 24.0 Gy. The glow curves were observed between 155 °C to 287 °C. The results of TL dosimeter subjected to 6, 9 and 12 MeV electrons clearly showed that PFF was superior in terms of TL response and sensitivity. This was followed by Ge, DFF, TLD-100, FF, PCF, Er, Al: Tm, MPCF 2 mm and MPCF 220 µm. For X-ray irradiation, the SMF showed 10 and 8 times more sensitive than TLD-100. The MDD obtained from optical fibres subjected to electron irradiation were between 0.53- 0.60 mGy for PFF, 0.78-0.81 mGy for TLD-100, 1.00-1.26 mGy for Ge and 1.44-1.64 mGy for DFF. The results showed that PFF and SMF have great potential to be considered as a radiation dosimeter.
ABSTRAK

Sifat dosimetri bagi dosimeter luminesens terma (TL) seperti sambutan dos, kelinearan, kepekaan, kepudaran, dos minima berkesan (MDD), lengkung berbara dan kebolehulangan bagi gentian optik telah dibandingkan dengan TLD-100 (jenis rod) telah dikaji. Sampel yang digunakan adalah Gentian Datar Palsu (DFF), Gentian Datar (FF), Gentian Hablur Fotonik (PCF), Gentian Hablur Fotonik Berbilang (MPCF) berdiameter 2 mm dan 220 µm, Gentian Fotosensitif Datar (PFF), Gentian Optik Mod Tunggal (SMF), Germanium terdop (Ge), Erbium terdop (Er) dan Aluminium terdop Thulium (Al: Tm). Sampel TL diletakkan di fantom pepejal dan disinar dengan alur elektron bertenaga 6, 9 dan 12 MeV mempunyai julat dos dari 1.0 Gy ke 4.0 Gy dengan menggunakan mesin pemecut linear (LINAC). Kajian turut dijalankan bagi sinaran - X dengan tenaga purata 30, 60 dan 70 kV, dan sinar gamma ($^{60}$Co) dari 1.0 mGy hingga 24.0 Gy. Lengkung berbara dicerap di antara 155 °C – 287 °C. Dapatan bagi dosimeter TL tertakluk kepada 6, 9 dan 12 MeV elektron jelas menunjukkan bahawa PFF adalah baik dari segi sambutan TL dan kepekaan. Ini diikuti oleh Ge, DFF, TLD-100, FF, PCF, Er, Al: Tm, MPCF 2 mm dan MPCF 220 µm. Bagi dedahan kepada sinar - X, SMF menunjukkan 10 dan 8 kali ganda lebih peka berbanding TLD-100. MDD yang diperoleh daripada gentian optik tertakluk kepada sinar elektron adalah di antara 0.53 – 0.60 mGy bagi PFF, 0.78 - 0.81 mGy bagi TLD-100, 1.00 - 1.26 mGy bagi Ge dan 1.44 - 1.64 mGy bagi DFF. Dapatan menunjukkan bahawa PFF dan SMF mempunyai potensi besar untuk dipertimbangkan sebagai dosimeter sinaran.