A feasibility study of novel real-time personal dosimeter with position monitoring

Sun Young Moon, BS[1,2], Jaehyeon Seo, BS[1],

Myonggeun Yoon, PhD[1,*] and Dongho Shin PhD[2,*]

[1] Department of Bio-convergence Engineering, Korea University, Seoul, Korea

[2] Proton Therapy Center, National Cancer Center, Goyang, Korea

Purpose: Personal dosimeters are used to measure the amount of radiation exposure in individual radiation workers. We aimed to replace existing personal dosimeters and evaluate a real-time scintillator-based dosimeter, by monitoring its radiation dose and checking the location exposed to radiation in the workspace.

Materials and Methods: Developed dosimeter measured the radiation dose based on a scintillating fiber (SF) bundle and comprised a silicon photomultiplier (SiPM), ultra-wide-band (UWB)-based location detecting system, and Bluetooth system. The SF bundle was exposed by radiation-emitted light and the photons were amplified and converted to electrical signals through the SiPM. These signals were transferred to the user through the Bluetooth system and monitored. In order to evaluate the feasibility of this mechanism as a dosimeter, we performed characteristic tests, such as dose linearity, dependence on dose rate, energy, exposed angle, and location coordinate mapping. Also, the dose distribution formed in circles around the iso-center was measured to confirm the feasibility of monitoring the exposure dose and location, to enable the radiation worker to move freely in a workspace.

Results: We confirmed dose linearity, independence from energy and angle, and accuracy of location monitoring in our device. The user's locations were measured with an error of -6 cm and -4.8 cm the x and y axes, respectively. The measured doses on our developed dosimeter were 62.7, 32.3, 21.0, and 15.4 mSv at distances of 50, 100, 150 and 200 cm from the iso-center. In other words, all measured doses at the several points showed an error within 5% as compared to the conventional pocket dosimeter.

Conclusions: These results show that the developed SF-based dosimeter is advantageous in monitoring the exposure dose and location in real time, and also has significant potential as a new personal dosimeter for radiation workers.

Keywords: Personal dosimeter, Scintillator, Occupational dosimetry, Real-time dosimeter.