

Overview of Digital EPR Spectrometer Optimized for in vivo Tooth Dosimetry

Jeonghun Oh¹, Chang Uk Koo¹, Jong In Park², Kwon Choi¹, Sung-Joon Ye^{1,3,*}

¹Program in Biomedical Radiation Sciences, Department of Transdisciplinary Studies, Graduate School of Convergence Science and Technology, Seoul National University, Seoul, Korea

²Korea Research Institute of Standards and Science, Daejeon, Korea

³Biomedical Research Institute, Seoul National University Hospital, Seoul 03080, Republic of Korea

*Corresponding author: sye@snu.ac.kr

Keywords: electron paramagnetic resonance (EPR), retrospective dosimetry, digital signal processing, automatic control, in-vivo measurement

Electron Paramagnetic Resonance (EPR) spectroscopy is one of the powerful technique to detect free radicals in the sample. Because stable radicals could be formed in the human tooth by radiation exposure, absorbed dose could be estimated by measuring the EPR signal amplitude. In conventional X-band (8-12 GHz) EPR tooth dosimetry, necessity of tooth extraction for sample preparation limited the application of the technique. In-vivo EPR tooth dosimetry using L-band (1-2 GHz) was introduced to evade dielectric loss occurs in direct measurement. L-band EPR tooth dosimetry has been considered as a suitable dose estimation method of triage. To improve the dose estimation accuracy of in-vivo dosimetry, limited signal-to-noise ratio (SNR), and unstable coupling state caused by patient motion should be resolved. Therefore, digital EPR spectrometer optimized for in-vivo tooth dosimetry has been developed (see figure 1). The down-converted EPR signal is directly converted to digital, and simultaneously demodulated to acquire multiharmonic signals. The signal conditioning components were connected prior to analog-to-digital converter (ADC) to optimize signal conversion. An electronically controlled tunable resonator was fabricated using passive tunable integrated circuit (PTIC) to compensate patient's motion automatically. A new optimized magnet system was fabricated for in-vivo measurement of patient's incisor.

In conclusion, by these advanced components, the accuracy of dose estimation and measurement time could be improved substantially. In addition, in-vivo measurement data of radiologically treated patients would be acquired to obtain accurate calibration curve of dose estimation.

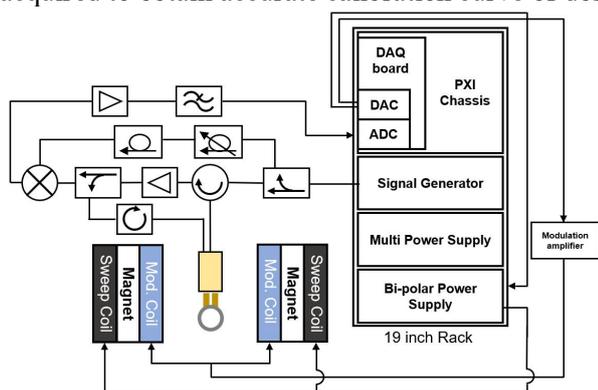


Fig. 1. Simplified block diagram of developed EPR spectrometer

Acknowledgments

This work was supported by the Nuclear Safety Research Program through the Korea Foundation Of Nuclear Safety(KoFONS) using the financial resource granted by the Nuclear Safety and Security Commission(NSSC) of the Republic of Korea. (No. 2003021)

