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Luminescence and radiation sensing across a wide range of doses and dose rates

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We are developing radioluminescence (RL) and passive light-generating systems for a range of applications, initial studies concerning doped silica optical fibers and time-resolved radiation dosimetry. Merits for biomedical interests include high spatial-and-temporal resolution, wide dynamic range, and real-time operability in various in vivo and ex vivo environments. For Ge-doped optical fibers irradiated using a linac at rates between 0.1- and 600 MU/min (and pulse durations of a few μs), linear response has been obtained with counting circuit gate times of between 50 and 100 μs, responses being largely free of the degrading effects of afterglow. Subsequent radiation processing dosimetric studies have concerned evaluation of kGy doses using undoped silica fibers of differing hydroxyl (OH) content. For electron doses from 10- to 70 kGy, greater OH content has been observed to provide the greater sensitivity while reduction in OH content leads to a shift towards longer wavelength in the peak wavelength of the RL spectrum. For the low dose regime of NORM (naturally occurring radioactive material) and contaminant depositions internal to pipework, various of the more conventional active devices have difficulty in localizing the presence of the beta active radionuclide 210Pb, most particularly in relation to downstream gas pipelines. Characterization has been made of an optical fiber system based on a LYSO:Ce scintillator, tested to-date for a range of μGy/h dose rates. Results point to a number of potential applications, not least verification of contaminant-free pipework subsequent to cleansing operations using high-pressure water jetting, also various industrial and security scenarios applications. If time allows, finally we will examine a PTFE tape photoluminescence reader combination, creating the possibility of a passive system of dosimetry in medical diagnostic applications and radon measurement evaluations.

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