GEANT4 simulation of the angular dependence of TLD based monitor response

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In this work the response of thermoluminescent monitors to X-ray beams impinging on them at different angles was investigated and compared with results of simulations performed with the GEANT4 radiation transport toolkit. Each monitor contains four thermoluminescent detectors (TLD): two CaF_2 pellets and two TLD-100 (one of each type within lead filter and the other without filter). This set of detectors allows the determination of photon energy. Monitors were irradiated free-in-air with beams of narrow and wide spectra with effective energies of 34, 61 and 130 keV and angles of incidence of 0°, 30°, 45° and 60° using a X-ray Philips MG-450 tube. Curves of thermoluminescence response relative to air kerma as a function of photon effective energy for each detector experimentally obtained are used to correct the energetic dependence of TL response. Such curves were also obtained from the data of radiation energy stored into the TLDs provided by the simulations. The differences between experimental results and the Monte Carlo simulations indicate that the dose distribution is strongly affected by the thickness of lead filter, which attenuates the intensity of radiation incident on the monitor. The attenuation increases with the increase of the incidence angle, since the thickness of lead traversed by the beam also increases. As the monitor calibration is usually performed with the beams impinging the monitor at 0°, changes in the attenuation become a source of error in the energy determination and consequently in the value of dose equivalent which is obtained with this monitor. Correction factors to compensate this effect can be evaluated with Monte Carlo simulations.

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