Experimental Validation of Energy Dependences of YAP TL Detectors: Irradiation to ISO Radiation Qualities

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Energy dependence of the energy deposition values is an important characteristic both for scintillators and radiation storage phosphors. For low-Z materials, for which inelastic scattering (Compton interaction) of photon radiation dominates for radiation energies from about 10 keV to 10 MeV, such energy dependence is of less significance. However, for high-Z materials, for which the photoelectric effect dominates especially for lower radiation energies, such energy dependence should be considered. As it was shown recently, the energy response of YAP:Mn-based thermoluminescent (TL) detectors (Z_{eff} = 31.4) of 1 mm thickness to photon radiation is about 40 times higher for 55 keV than that for Co-60 (1.25 MeV) [1].

The present work demonstrates experimental results obtained for single crystalline YAP:Mn detectors irradiated to photon radiation of different radiation qualities modified by various metal (copper, aluminum, tin) filters of thickness from 2 to 6 mm. For this purpose the following ISO standard radiation qualities were used: X-rays of N-40 (effective energy 33 keV), N-60 (48 keV) and N-100 (83 keV), γ-radiation series S-Cs (Cs-137, 662 keV) and S-Co (Co-60, 1.25 MeV). These results are compared with results of Monte Carlo simulations of the value of energy deposition (which is assumed to be proportional to the luminescence output of the detectors) done for the same 'radiation-attenuator-detector' combinations.

The analysis shows good agreement between experimental and calculated results that testifies adequacy of the used calculation approach and their applicability to modulate an output from high-Z TL detectors exposed to radiation of different qualities.

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[1] Ya. Zhydachevskii, A. Morgun, S. Dubinski, Yan Yu, M. Glowacki, S. Ubizskii, V. Chumak, M. Berkowski, A. Suchocki, Energy response of the TL detectors based on $YAlO_3$:Mn crystals, *Radiat. Meas.* **90** (2016) 262-264.