THEORETICAL CALCULATIONS AND SIMULATIONS OF INTERACTION OF X-RAYS WITH HIGH-Z NANOMOITIES FOR USE IN CANCER RADIOTHERAPY

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When used with X-ray radiotherapy, heavy elements (high atomic number Z or HZ) such as gold(Au) and platinum(Pt) have the potential to greatly sensitize and enhance the damage to tumor tissues. While HZ radiosensitization has been shown to be higly effective in reducing tumor sizes, much work still needs to be done to determine the ideal X-ray energy/energy spectrum. The likelihood of photoelectric absorption of X-rays that result in the production of cell-killing Auger electrons relative to the photon scatter in an HZ sensitized tumor has to be determined for treatments using X-rays from various sources and energies to assess their efficacy. In this report, we present computations that outline the dependence of photoelectric absorption on X-ray energy. The relative X-ray absorption by a radiosensitized tumor was calculated to contrast the efficacy of different X-ray sources in Auger electron production at different tumor depths. Enhanced photoabsorption of low-energy X-rays from broadband sources in the keV range is shown to be much higher than from those in the MeV range. In addition, with the use of the Monte Carlo code package Geant4, we present the total X-ray energy deposited into a radiosensitized tumor located at different depths in a phantom. The enhancement in radiation dose deposition will also be analysed at the microscopic cellular level to determine the HZ radiosensitizer concentration required. Potential use of monochromatic X-rays for more precise HZ radiosensitization will also be described.