New Design Of Optical CT Microscanner For High-Resolution 3D Dosimetry Using BANG® Gels

Optical CT microimaging of BANG® gels was recently introduced[1] for 3D near-field dosimetry of brachytherapy sources. In BANG gels, radiation-induced polymerization produces permanent 3D images of dose distributions.

Initially, the rotating cylindrical gel vial was immersed in a refractive index matching liquid in a tank which was translated across a stationary laser beam. That design, despite producing encouraging performance test results, needed improvement, because even trace amounts of dust or microbubbles in the tank liquid could cause image artifacts, and vibrations from the translation motor contributed to noise.

The new design, which we call "dry scanner", employs neither the tank with the matching liquid nor the translation of the gel. The laser beam is first focused and then reflected by a rotating mirror whose center of rotation coincides with the focal spot of the rotating cylindrical gel vial (for paraxial rays, within about 1/3 of the vial radius). A photodiode located at the opposite focal spot of the gel vial collects the transmitted light. Filtered back projection is used for reconstructing the image of dose distribution in the gel.

We tested the performance of the "dry scanner" for linearity, spatial uniformity, noise, and for reconstructing the images of test patterns. We found the results very satisfactory and promising. The "dry scanner" may find use in many clinical applications.

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[1] Maryanski et al, Med.Phys.25(7), Part 1, p.A107, 1998