Title: Carbon Nanotubes Role in kV x-rays: Enhancement or Diminution?

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Purpose: To experimentally ascertain the impact of carbon nanotube (CNT) on deposited energy in solid water by keV x-rays. In our previous work, we have found that adding CNTs to water enhances the measured dose deposited by x-ray beams in the MeV range.

Methods: The radiation dose from 80,100,120,140 kVp x-rays was measured using an ion chamber at 1 cm depth in a solid water a phantom. In an area of 5 cm x 5 cm, a layer of carbon nanotubes in two forms (foil and powder) was placed on the surface of the phantom, at 99 cm SSD. The pinpoint-type ion chamber is at 100 cm SAD, a centimeter below the carbon nanotubes. The measured dose enhancement ratio (DER) is the ratio of the dose to solid water + CNTs / dose to solid water only.

Results: With CNTs in tape form, the measured DERs are 1.089, 1.083, 1.020 and 1.016 for 80 kVP, 100 kVp, 120 kVp and 140 kVP, respectively. When the tape CNTs is replaced by 650 mg of powder form CNTs, the measured DER is 1.089, 1.083, 1.051 and 1.048 for 80 kVP, 100 kVp, 120 kVp and 140 kVP, respectively.

Conclusion: For all measured energies, the dose was enhanced when carbon nanotubes were added to the beam path. The dose increase is as high as 9% for 80 kVp and as low as 2% for 140 kVp.