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Preliminary investigation of the characteristics of selected additive manufacturing materials for microbeam radiation therapy at the Australian Synchrotron- Imaging and Medical Beamline (IMBL)

Additive manufacturing (AM) or 3DAM printing is an active field of research in medical radiation physics. Creating patient-specific devices to improve current radiotherapy practice is highly desired. MeV X-ray and keV X-ray radiation interaction processes can differ significantly, hence it is essential to understand the physical and attenuation properties of these AM materials. The monochromatic imaging and microbeam radiation therapy capabilities of the ANSTO AS IMBL beamline can provide essential data to progress this research via precise radiation treatment planning. 3DAM printed phantoms offer new development opportunities and improved quality assurance outcomes in both synchrotron X-ray and advanced clinical radiation therapies. Monoenergetic computed tomography imaging (30keV to 65keV) and broad beam dosimetry were utilized for 15 AM materials and were compared relative to standard radiotherapy materials (RMI457 Solid Water, and bolus). Based on the attenuation coefficients acquired through monoenergetic CT, Polylactic Acid (PLA+) polymer shows similar attenuation properties to water liquid, and ICRU soft tissue with a maximum percent difference of 7.14% and 12.36%, respectively. Polypropylene was found to best approximate RMI457 Solid Water within +/-2% for 4TMoMo and 4TAlAl broad beam dosimetry. While the rest of the AM materials match bolus material by +/-5% (4TMoMo, 4TCuCu) and +/-6% (4TAlAl). These results can be a basis for designing and fabricating customizable imaging and dosimetry phantoms.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

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