World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:8, No:11, 2014

Development of a Laboratory Laser-Produced Plasma "Water Window" X-Ray Source for Radiobiology Experiments

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Abstract : Laser produced plasma light sources, emitting high intensity pulses of X-rays, delivering high doses are useful to understand the mechanisms of high dose effects on biological samples. In this study, a desk-top laser plasma soft X-ray source, developed for radio biology research, is presented. The source is based on a double-stream gas puff target, irradiated with a commercial Nd:YAG laser (EKSPLA), which generates laser pulses of 4 ns time duration and energy up to 800 mJ at 10 Hz repetition rate. The source has been optimized for maximum emission in the "water window" wavelength range from 2.3 nm to 4.4 nm by using pure gas (argon, nitrogen and krypton) and spectral filtering. Results of the source characterization measurements and dosimetry of the produced soft X-ray radiation are shown and discussed. The high brightness of the laser produced plasma soft X-ray source and the low penetration depth of the produced X-ray radiation in biological specimen allows a high dose rate to be delivered to the specimen of over 28 Gy/shot; and 280 Gy/s at the maximum repetition rate of the laser system. The source has a unique capability for irradiation of cells with high pulse dose both in vacuum and He-environment. Demonstration of the source to induce DNA double- and single strand breaks will be discussed.

Keywords : laser produced plasma, soft X-rays, radio biology experiments, dosimetry
Conference Title : ICMPRPR 2014 : International Conference on Medical Physics, Radiation Protection and Radiobiology
Conference Location : Paris, France
Conference Dates : November 21-22, 2014