FOCUSED X-RAY PROBES FOR STUDIES OF RADIATION INDUCED CANCERS: A CASE STUDY IN INTEGRATING SOURCES AND OPTICS

A. Michette*

King's College London, Department of Physics, University of London, WC2R 2LS, Strand, London, UK

* *e-mail*: alan.michette@kcl.ac.uk

This presentation describes a case study in integrating a laboratory-scale X-ray source with appropriate optics for a particular application, namely the study of radiation-induced cancers. Previous work [1] using carbon K X-rays (284 eV) from a microfocus source, focused using zone plates onto individual biological cells, allowed studies of phenomena such as the bystander effect, whereby unirradiated cells in a collection in which only one is irradiated display signs of radiation damage. This may be related to another effect, low-dose hypersensitivity, in which more cells are damaged at very low doses than would be expected from extrapolations from high doses. However, to date it has only been possible to study cell death, rather than the much more important — for understanding of cancers — effect of mutations. Additionally, it is also important to study effects in tissue samples, as these will be more relevant to living organisms. In order to achieve these aims, it is necessary to deliver higher dose rates (so that more material can be irradiated in a given time) at higher energies (to penetrate into tissue). We are developing a microfocus source that will provide chromium K_α X-rays (5.4 keV) focused to a sub-micrometre spot using custom-built microstructured optical arrays [2] that use two successive grazing-incidence reflections from channels etched in silicon. The arrays, which will deliver about two orders of magnitude more focused flux than a zone plate, may be flexed using piezo actuation to provide focal length control and reduction of aberrations. Progress in the design, construction and characterization of the source and optics will be discussed.

References

[1] M. Folkard, K.M. Prise, A.G. Michette, B. Vojnovic, *Nucl. Instrum. Methods* **A580**, 446 (2007).

[2] A.G. Michette, S.J. Pfauntsch, S. Sahraei, M. Shand, G.R. Morrison, D. Hart, B. Vojnovic, T. Stevenson, W. Parkes, C. Dunare, R. Willingale, C.H. Feldman, T.W. Button, D. Zhang, D. Rodriguez-Sanmartin, H. Wang, A.D. Smith, *Proc. SPIE*, **7360**, 736007 (2009).