Contribution ID: **1066** Type: **Poster**

Dosimetric characterisation of SCIOX Beam, an X-ray cabinet for experimental radiation chemistry

Thursday, May 19, 2022 5:47 PM (8 minutes)

Cabinet X-ray instruments are used in various fields. They are primarily used for security screening or industrial quality control. Security applications comprise airport baggage security screening, cargo inspection of trucks crossing international borders and food inspection to check for foreign objects; industrial applications often involve circuit board inspection to find defects or tire inspection to identify manufacturing defects. Many X-ray cabinets are also used for medical applications or research. X-ray cabinet SCIOX Beam is a custom-made research device newly installed at the Department of Nuclear Chemistry at the Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague.

This device is equipped with two wide-angle tungsten X-ray tubes with variable voltage and current settings, allowing irradiation by variable X-ray spectra. The low-energy X-ray tube works in a high voltage range of 4 –60 kV with an output current of up to 3 mA (output power 0,4 –50 W). The high-energy X-ray tube works in a high voltage range of 50 - 350 kV with an output current of up to 30 mA (output power 5 –4200 W). The lead-shielded irradiation chamber has rather large dimensions of 750 x 750 x 720 mm and includes a movable shelf controlled by the machine software. In addition, there is a switchable light source, a camera, a temperature sensor and a computer-controlled ventilating fan in the chamber. A scintillating plate can be inserted into the chamber to check the width and extent of the X-ray beam on the current shelf position.

The main goal of the presented work is the dosimetric characterisation of beams generated by the X-ray cabinet SCIOX Beam. It involves a determination of the dose rate at different sample positions in the cabinet and its relation to operational parameters of the X-ray tube(s) –voltage and current. The dose rate was determined by a Fricke dosimeter for different source-to-surface distances (SSD). The linearity of dose to irradiation time and repeatability was also evaluated. All such parameters are of utmost importance for any radiation-chemical evaluations using this new cabinet X-ray apparatus.

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Session Classification: Radiation Chemistry

Track Classification: Radiation Chemistry