MICROGAP GAS DETECTOR RAPID

RAPID (Refined ADC Per Input Detector) is a two-dimensional gas multi-wire detector developed at CCLRC Daresbury Laboratory in the U.K. The major advantage of RAPID is its fast response, enabling one to measure up to 20 million photons per second. Additionally, since RAPID is a photon counting detector, its wide dynamic range and low noise are advantageous compared with integrating detectors such as an imaging plate and CCD-based detectors.

RAPID has two sets of electrodes arranged at right angles: one is a set of parallel copper tracks on a PC board which work as cathodes, the other is a parallel array of gold-plated 10-∝m-diameter tungsten wires separated by 0.8 mm spaced at 0.5 mm from the cathodes, which work as anodes (Fig. 1). An X-ray photon causes a discharge in the detector which is filled with an argon/xenon-based gas. The discharge induces electric pulses on both anodes and cathodes which are measured by analog-to-digital converters (fast flash ADC). The small distance (microgap) between the anodes and the cathodes ensures that the electric charges generated by a gas discharge dissipate quickly. This enhances the response time of the detector and increases the number of photons that can be counted per second. Usually the charges are induced on more than one electrode. The position of an X-ray photon is calculated by interpolation using signals from three neighboring electrodes. Signals from the anodes and cathodes are correlated to locate a photon two-dimensionally. The positions of photons are stored in a histogram memory. The detection area is 20· 20 cm^2, which is divided into 1000· 1000 channels.

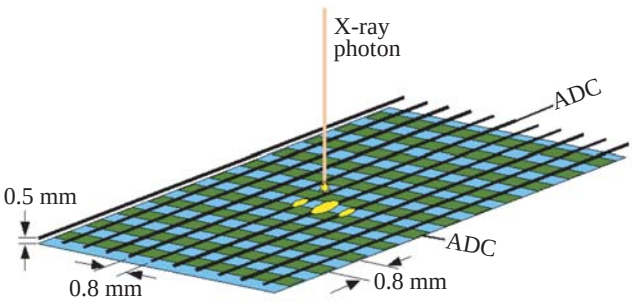

Fig. 1. Schematic drawing of the arrangement of electrodes in RAPID. An X-ray photon induces charges on both anodes (wires) and cathodes (strips).

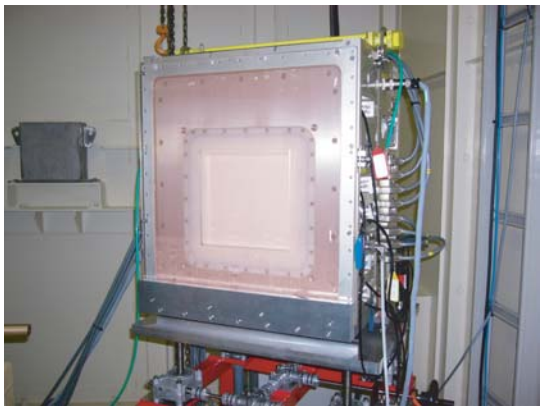

Fig. 2. RAPID detector installed in the experiment hutch of BL40B2.

A new model of RAPID was manufactured at Daresbury Laboratory for SPring-8, and has been installed at beamline **BL40B2** in May 2005 (Fig. 2). Its performance test proved that its wide dynamic range and low noise make it the most suitable detector for measuring diffraction and scattering from non-crystalline materials such as polymers and protein solutions (Fig. 3).

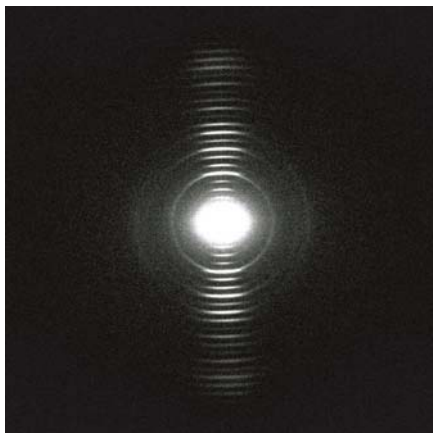

Fig. 3. Diffraction pattern of dried chicken tendon collagen recorded with RAPID.

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References

[1] R.A. Lewis *et al.*: Nucl. Instrum. Meth. A **454** (2000) 165.