A remote-control direct-beam exposure device for the Arndt-Wonacott rotation camera

When recording protein or virus crystal X-ray diffraction data on the rotation camera the successful indexing of reflections on each film requires the origin of the pattern to be accurately defined. This is usually achieved by recording three reference marks (fiducials) in the corners of the film. These marks also define a coordinate system in the film as well as the origin of the pattern. As the density of diffraction spots has increased with the study of large unit cells, errors in the reproducible positioning of fiducials on separate cassettes have been checked by recording the direct beam. This has been achieved by removing the backstop manually and quickly activating the camera shutter. Such a procedure has been adequate, though tedious, on conventional X-ray sources with the present range of unit-cell sizes. However, it has become more onerous since the introduction of camera safety enclosures. At the Daresbury Synchrotron Radiation Source (SRS), as at other such sources, e.g. LURE and DORIS, exposure times are much reduced over that of a conventional source. The time to remove manually the backstop and place a suitable attenuator in the beam to record a small direct-beam spot is a significant amount of beam time. The higher intensities also encourages the study of larger and larger unit cells so that cell constants well in excess of 1000 Å can be contemplated. The need for an increasingly accurate definition of the origin of the pattern is paramount for correct indexing; this is especially true if the sample is so exceedingly sensitive to radiation damage that the crystal orientation cannot be set accurately before the (only) data photograph. We report here a simple modification to the standard Enraf-Nonius backstop for the reproducible movement of the backstop 'out' and 'back into' the beam by remote control. The time spent out of the beam is variable and the total movement such that a small piece of metal foil adjacent to the backstop attenuates the direct beam in the 'out' position and lies in the pattern 'blind region' when the backstop has been returned to trap the beam.

The modified backstop holder includes a swivel joint coupled to a solenoid. When the solenoid is energized, the swivel rotates to give a 1–2 mm movement of the beam stop in the horizontal plane perpendicular to the X-ray beam. When the solenoid is de-energized, a spring returns the swivel to its normal position, ensuring this with a limiting screw. The DC solenoid is operated by a push button which activates a de-bounced monostable pulse, driving a power transistor. The time spent out of the path of the direct beam by the beam stop is variable by a front panel potentiometer, to a minimum of ~10 ms. A view of the mechanical arrangement is shown in Fig. 1 and a diagram of the simple circuit in Fig. 2. One limitation of the present design is the restriction of the minimum crystal-to-film distance to 80 mm. This corresponds to a resolution limit of 2.38 Å at an incident wavelength of 1.488 Å and of 1.76 Å at a wavelength of 1.1 Å.

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