

An Ultra-fast Mechanical Shutter for Sub-microsecond Time-resolved Experiments

Milan Gembicky, Philip Coppens, *Department of Chemistry, State University of New York at Buffalo, NY 14260-3000, USA*. E-mail: gembicky@buffalo.edu

A new high speed, high rep-rate X-ray beam shutter for time-resolved photo crystallography [1] at synchrotron sources has been developed and tested. The new design is based on a commercially existing DC servomotor and a frequency-lock control capable Linear Amplifier. Accurate speed control combined with an air bearing results in extremely low jitter in the motor rotation. Measured jitter at rotation speeds of 200 Hz to 500 Hz is less than 2 ns at a 6σ level confidence. The chopper disk is interchangeable, allowing maximum flexibility. The current chopper disc with 45 radial slots allows synchronizing with the APS storage ring from the 12th to the 24th subfrequencies, corresponding to X-ray pulse frequencies of 11.3 to 22.6 kHz. At 30000 RPM the opening time for 350 μm slots is 1.65 μs , i.e. less than half the orbit time at the APS source. Results demonstrate that low cost components can be used to build an exceptionally precise instrument. The shutter provides high accuracy and efficient use of X-rays at a modest cost.

[1] Coppens P., Vorontsov I., Graber T., Gembicky M., Kovalevsky A. Y., *Acta Cryst.*, 2005, **A61**, 162-172.

Keywords: photo-crystallography, synchrotron, ultra-fast shutter