Cryocrystallography: Present Highlights and Future Prospects

Elspeth Garman
University of Oxford, UK

Advances in cryocrystallographic techniques over the last eight years (precipitated by[1] and further developments reviewed in[2] and[3]) have made a significant impact on the utility of second- and third-generation synchrotron radiation for macromolecular crystallography. In many cases, these techniques are now an essential ingredient for collection of good quality diffraction data and are enabling full exploitation of the intense x-ray beams available. The impetus for the new developments has been the greatly reduced radiation damage observed in crystals flash-frozen and held at around 100 K during data collection. However, there are additional benefits of cryo-techniques, resulting in new experimental possibilities (e.g., use of microcrystals and very fragile crystals, ultra-high resolution data, MAD, cryo-enzymology, and virus crystallography), some of which will be highlighted in this talk. The advent of more intense synchrotron beams will involve a dual challenge to contain the inevitable increase in radiation damage: Can we collect data even faster to minimize the time dependent component, and can we achieve any additional protection of crystals from the dose-dependent damage? The new generation of CCD detectors is improving the duty cycle during synchrotron data collection, thus reducing the time for which a crystal must survive after initial irradiation. The recent announcement of a commercially available open-flow helium cryostat for use with single crystals paves the way for serious experimentation down to a temperature of around 30 K. Primary radiation damage is *de facto* unavoidable, but will the spread of secondary damage be affected by reducing the temperature of the cryo-data collection?

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[1]T. Y. Teng (1990) J.Appl. Cryst. 23, 387-391.
[2]D. Rodgers, (1997) Methods Enzymol, 276, 183-203.
[3]E. F. Garman and T.R. Schneider, (1997) J. Appl. Cryst. 30, 211-237.