Radiation Damage of Protein Crystal at Cryogenic Temperatures Between 40 K and 150 K

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After the completion of our study on X-ray radiation damage of protein crystals at 100 K [1], it was logical to ask if the findings hold at cryogenic temperatures other than 100 K. The question is especially interesting for even lower, liquid helium, temperature, since a few groups have commented that liquid nitrogen temperature seemed not low enough to minimize radiation damage for their biological system.

Although little difference was anticipated, because primary radiation damage is independent of temperature, a systematic study was designed and performed. Four hen egg white lysozyme single crystals were studied at two additional temperatures, 40 K and 150 K. For two crystals, the same strategy as in the previous study was employed, namely, acquire data on a crystal until it showed severe radiation damage at a constant temperature of 40 K or 150 K. Two other crystals were used to take data continuously, but the temperature was cycled between 40 K and 100 K (or 150 K and 100 K) from one data set to the next.

Results confirm the findings of the previous study. Independent of temperature, primary radiation damage depends linearly on X-ray energy absorbed up to an observed upper limit. It is also interesting that, though primary damage is independent of temperature, the quality of the data at 40 K is better than those acquired at 100 K.

[1] Teng & Moffat (2000). J. Synchrotron Radiat. **7**, 313-317