Outrunning radiation damage in synchrotron biological small angle X-ray scattering

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Small angle X-ray scattering (SAXS) is a popular technique for obtaining structural information from macromolecules and complexes in solution. Biological samples are sensitive to damage from X-rays consequently radiation damage places serious constraints on SAXS experiments. Damage typically manifests as aggregation of the sample, which changes the scattering and can make data interpretation impossible. One possible way to prevent radiation damage from altering the measured scattering is to collect the data faster than damage can physically manifest in the system, i.e., to effectively 'outrun' the radiation damage. We collected SAXS data on protein solutions at the European Molecular Biology (EMBL) P12 bioSAXS beam line at DESY (Hamburg, Germany) equipped with a double multilayer monochromator, delivering a maximum dose rate greater than 1 MGy/s, and an Eiger 4M (Dectris) detector, which has a maximum frame rate of 750 Hz. We present results showing that as the dose rate is increased, the observed damage per unit of dose in a sample decreases, illustrating that some damage can be outrun in biological SAXS at current synchrotron beam lines.

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