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Radiation damage in X-ray spectroscopy

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X-ray spectroscopy probes the electronic structure around an analyte element in a sample. The electronic structure relates to the formal oxidation and spin state and the atomic structure around the analyte element. The sensitivity to small modification of the electronic structure makes X-ray spectroscopy strongly responsive to small changes of the sample due to X-ray irradiation. Thus, X-ray spectroscopy often tolerates lower doses than atomic structural probes such as crystallography. The effect of X-rays in the sample may be oxidation or reduction of a metal site accompanied by modification of the local atomic coordination. Often, X-rays induce changes similar to other external triggers such as optical/UV illumination or temperature. This can be used to understand the changes in the sample, i.e. X-rays serve as source and probe of the sample modification. Radiation damage dramatically changes the experimental protocol to record spectroscopic data and some measurements become impossible. The presentation provides examples and discusses some fundamental concepts.

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