Synchrotron and soft X-rays (18-21)

18 Measurement of Absorption Spectra of Mammalian Cells and Cellular Components in the Soft X-ray Region

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Absorption spectrum of mammalian cells in the soft X-ray region was measured to obtain spectral feature over a wide range of wavelength and XANES feature at absorption edges in a cellular environment. In the spectrum of a pellet of CHO cells from 1.5 to 5nm, prominent XANES peaks at the Ca-L absorption edge were observed in addition to the large absorption jump at the C-K, N-K, and O-K edges. This suggests a unique application of XANES to 1) a sensitive mapping of minor elements and 2) cellular radiation effects induced by preferential absorption to the specific element or molecule. XANES spectra of whole cells and nuclear fraction at the N-K edge have two peaks at the identical energies to those of DNA and histone. Similar results were obtained for XANES of whole cells at the S-K edge in comparison with the spectra of glutathiones. However, at the O-K edge, a XANES peak observed in cells and nuclear fraction was slightly shifted from the spectra of mitochondrial fraction, DNA and histone. These results indicate that sensitivity of XANES profile to molecular environment depends on the absorption edges of constituent elements.

19 Modeling of Production Process of DNA Damage by X-ray Induced Inner-Shell Photoabsorption

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This study aimes at elucidating the production process of DNA damage due to low-energy Auger electrons from constituent atoms of DNA when irradiated with monochromatic X-rays. Photon induced Auger process in DNA solution was modeled and introduced to the Monte Carlo simulation code DBREAK, which allows the estimation of DNA strand break production on pBR322 plasmid DNA in aqueous solution. The coodinates of all constituent atoms of DNA are given, and the exact position of photoabsorption event can be sampled. Photoabsorption probability of each atom and subshell is determined in proportion to each photoabsorption cross-section. Spectrum and track structure of secondary electrons (photoelectron and Auger electrons) emitted from the constituent atom in the system after photoelectric effect can be calculated. The simulation can be carried out for the direct energy deposition events and the attack of diffusible radicals generated in the water. The production of strand breaks on supercoiled DNA in aqueous solution will be examined. The yield of strand breaks for different energy photon (just above and below the K-edge of phosphorus) will be compared.