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Dichroism in Retinal Tissue Revealed by Synchrotron Infrared Microspectroscopy

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Beamline(s): U10B

Introduction: The synchrotron illuminated confocal double pass, single masked, infrared microspectrometer (Nicolet Continuum®) at beamline U10B allowed polarization spectra to be recorded from narrow layers of retinal tissue. Dichroism measured at select wavelengths reveals the molecular orientation of organic functional groups occurring in nature. Microspectroscopy has the advantage over previous macro infrared polarization studies with specimens isolated from homogenates because the *in situ* microspectroscopy retains the order and spatial arrangement found in nature. Previous attempts to record good polarization spectra failed using a conventional global illuminated infrared microscope in our Kansas City laboratory. This was because the small spot size required to achieve the desired spatial resolution combined with the attenuation of the grid polarizer resulted in an insufficient signal to noise ratio. At U10B we were able to examine in detail the dichroism of the photoreceptor disks of the outer segments that are involved with the beginning of the sight process. Additionally orthogonally polarized spectra were obtained for individual retinal layers. In particular a definite angular dependence of dichroism was observed in the outer segment due to the phospholipids. The dichroism at 1235 cm^{-1} and $1065\text{-}1085\text{ cm}^{-1}$ was at a maximum within a certain number of degrees of a radial ray striking perpendicular to the retinal layers. The dichroism drastically diminished to a minimum at larger angles from the radial illumination. Future *in situ* photoreceptor segment experiments are planned now that we have established this new capability facilitated by synchrotron radiation.