Presented at the Undergraduate Research Summer Institute Symposium
Vassar College, September 17, 2003

Construction of the Circular Dichroism Tensor of Horse Oxyhemoglobin

Saad Akbar, Vassar College '05, and Werner Kaminsky, Bart E. Kahr, Department of Chemistry, University of Washington

The interaction of light with atoms is fundamental in illuminating a crystal's properties. In this study, the optical anisotropies of horse oxyhemoglobin (oxy-Hb) crystals were investigated. The impetus for this work, indeed, has been provided by novel instrumentation that is available to us, including a birefringence/dichroism imaging system and a circular dichroism (CD) imaging microscope. The automatic birefringence/dichroism imaging system was used to separate the optical anisotropy (| sin δ |), dichroism (tanh ε), optical orientation (Φ), and transmittance (I_0) of colored, birefringent oxyhemoglobin crystals into respective color coded images obtained with a high-resolution CCD camera. Significantly, the effects convolved with a standard polarizing microscope have thus been separated into individual components, and the subsequent images ready for qualitative and quantitative interpretations. This has enabled us to observe effects of linear birefringence (LB) and linear dichroism (LD) to accuracies previously unattainable. Furthermore, the first successful visible light circular extinction imaging microscope (CEIM), constructed by the group, is being used to experimentally elucidate the anisotropy of CD intrinsic to horse oxy-Hb. The conspicuously twinned, monoclinic crystals have exhibited strong circular extinction signals of opposite signs in different sectors. To ensure the absence of linear biases, azimuthal independence of these signals has been established. After the collection of further LB, LD, CD, and absorbance measurements is complete, including the CD of the mother liquor and finely powdered crystal, we will be in a position to propose the construction of a symmetric, second rank CD tensor of horse oxy-Hb, the first ever experimental determination of the CD tensor of an anisotropic crystal.