Three-dimensional Birefringence Imaging with a Microscope Tilting Stage

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We show that by combining the MetriPol™ imaging system (see www.metripol.com) with a microscope tilting stage it is possible to obtain very precise birefringence information on crystals. The MetriPol™ microscope uses a combination of a rotating polarizer and a circular analyzer to separate out three types of images, one representing the light transmission through the specimen, one showing the orientation of the optical indicatrix at any point in the image, and one giving quantitative information on $|\sin\delta|$, where δ is the phase difference introduced by the birefringent sample.

We demonstrate that it is possible to simulate the data closely using our optical equations for uniaxial and biaxial crystals in any general alignment, starting from the known birefringence values of the sample. In samples with a small retardance, where $|\sin\delta|$ is known to lie within the first period of the sine function, it is often possible to obtain values for the birefringence without any prior knowledge of the optical properties. We are currently investigating the use of multiple wavelength techniques to determine the absolute values of δ, as in the work of Geday, Kaminsky, Lewis & Glazer, (2000), in order to extend this technique to samples with a higher retardance. In addition, we hope to show that by constructing a suitable database of known optical properties of different materials, it should be possible to identify unknown crystalline grains in a microscope rock section.

[1] Glazer A.M., Lewis J.G., Kaminsky W., *Proc. Roy. Soc. London*, 1996, **A452**, 2751-2765. [2] Geday M.A., Kaminsky W., Lewis J.G., Glazer A.M., *Journal of Microscopy*, 2000, **198**, 1-9.

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