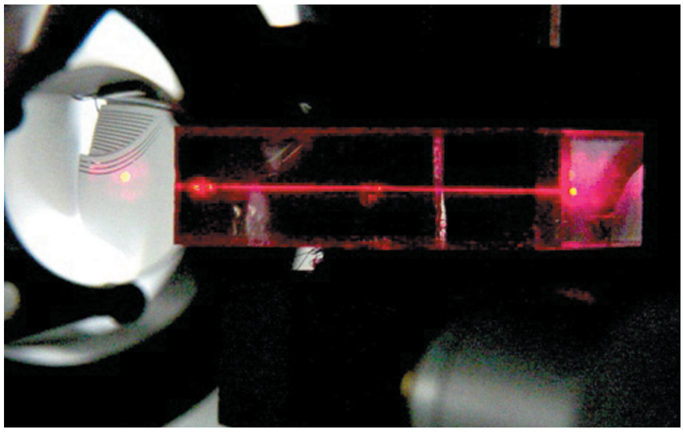
# Conical refraction as base of novel future applications

The curious optical effect known as conical refraction has been very hard to achieve to date because of the absence of suitable biaxial crystals. The first experiment on conical refraction was done in 1832 by Rev. Humphrey Lloyd of the Royal Irish Academy. He used an aragonite crystal of acceptable quality and was the first man in the world to see the effect of both internal and external conical refraction.

In the case of internal conical refraction you should see two concentric light rings known as Poggendorff rings. These Poggendorff rings appear at the exit facet of the crystal and can normally be seen very clearly by magnifying an image of the rings and projecting them with a simple lens onto a screen.

The quality of Lloyd's aragonite was not high enough to recognize two rings. It has to be mentioned that nearly all known existing aragonite crystals of sufficient size are not suitable for conical refraction and that aragonite cannot be produced synthetically.

Now in 2004, more than 170 years after Lloyds first experiments, researchers at Vision Crystal Technology AG (VCT AG) in Germany have achieved very high resolution conical refraction with the help of their synthetically grown, oriented, cut and polished monoclinic double tungstate (MDT) crystals.



*Onto the entrance facet focussed laser beam undergoes external conical refraction within a MDT crystal.*

With today's laser technology and suitable crystals the effect of conical refraction has promising applications.

The biggest advantage in all future applications will be that a minimal number of optical elements is required.

For example, the special polarization distribution within the beam profile caused by internal conical refraction makes it possible to depolarize monochromatic light using only one element, which could be an MDT crystal. The effect also can be used to create defined beam profiles. It becomes possible to convert a Gaussian beam profile into a "flat top" with help of one MDT-element.

The only parameters which have to be changed to achieve either depolarization or a flat beam profile, are the crystal length and the diameter of the incoming beam.

A further interesting application could become possible by external conical refraction, where under certain conditions a focussed monochromatic light beam passes the media without divergence as a small thin line. After leaving the exit facet spreads into a cone again. This behaviour enables constantly distributed high energy densities within the media and therefore especially becomes interesting for non-linear effects like Raman shifting or phase conjugations, especially in MDT, because this media possesses non-linear susceptibilities of higher order.

These few examples show that conical refraction in MDT could bring many interesting applications in the nearer future. For more information visit **www.vct-ag.com.**