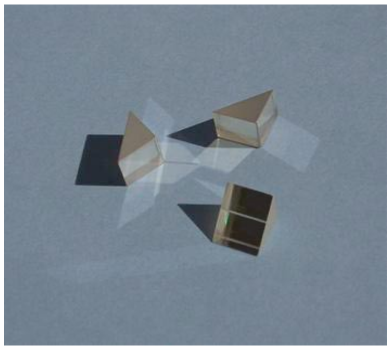
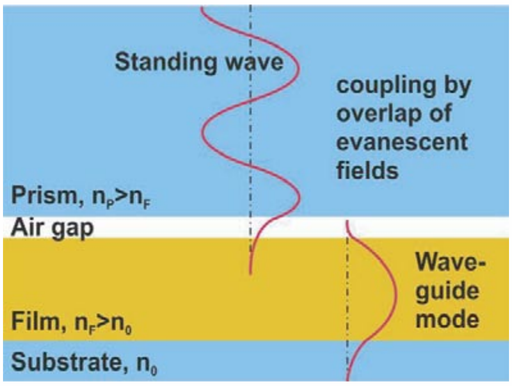
Rutile Coupling Prism

Del Mar Photonics offers optical elements made of high quality synthetically grown Rutile Titanium Dioxide crystals. Rutile's strong birefringency, wide transmission range and good mechanical properties make it suitable for fabrication of polarizing cubes, prisms and optical isolators. Boules having high optical transmission and homogeneity are grown by unique proprietary method. Typical boules have 10 - 15 mm in dia. and up to 25 mm length. Optical elements sizes - from 2 x 2 x 1 mm to 12.7 x 12.7 x 12.7 mm. Laser grade polish quality is available for finished elements.

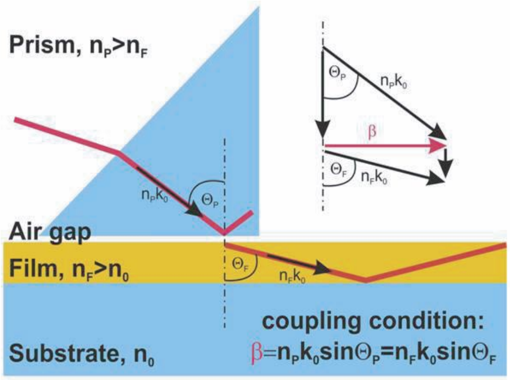


Research description for a Rutile coupling prism

This description will give a brief insight into our research at the Light Technology Institute of the University of Karlsruhe (TH), Germany. One of our research fields is the development of electrically pumped organic semiconductor thin film lasers. Due to the complex behavior of these lasers numerous electrical and optical characterization is necessary. One of the most important optical properties of these organic semiconductor laser structures is the attenuation coefficient of the multilayer waveguide, which has to be carefully optimized to reduce waveguide losses 1. The first step in the optimization process is the numerical simulation of the anticipated waveguide design. Next, the optimized sample structure is fabricated and characterized in our attenuation measurement setup. This measurement is done as follows: A Rutile coupling prism is pressed onto the waveguide. A laser beam is then coupled into the prism so that total reflection occurs inside the prism at the interface to the waveguide. In the vicinity of the waveguide the overlapping incident and reflected beam generate a standing wave. The evanescent field of that standing wave penetrates into the waveguide.



Evanescent field coupling



Beam coupling into waveguide

Under a certain angle and if the phase match conditions are fulfilled, the evanescent field stimulates a mode that is guided by the waveguide. The phase match condition can only be achieved when the refractive index of the prism is at least as high as the effective refractive index of the waveguide. Owing to its high refractive index, Rutile is an ideal material for use as a coupling prism in such a prism-coupler waveguide attenuation measurement setup.

A small fraction of the guided light is scattered out of the waveguide. The intensity of this scattered light is assumed to be proportional to the intensity of the guided light. Thus the intensity distribution inside the waveguide along the propagation direction can be directly determined through measuring the intensity of the scattered light.

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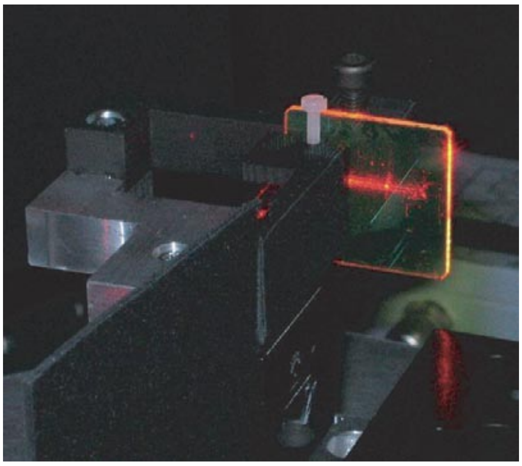
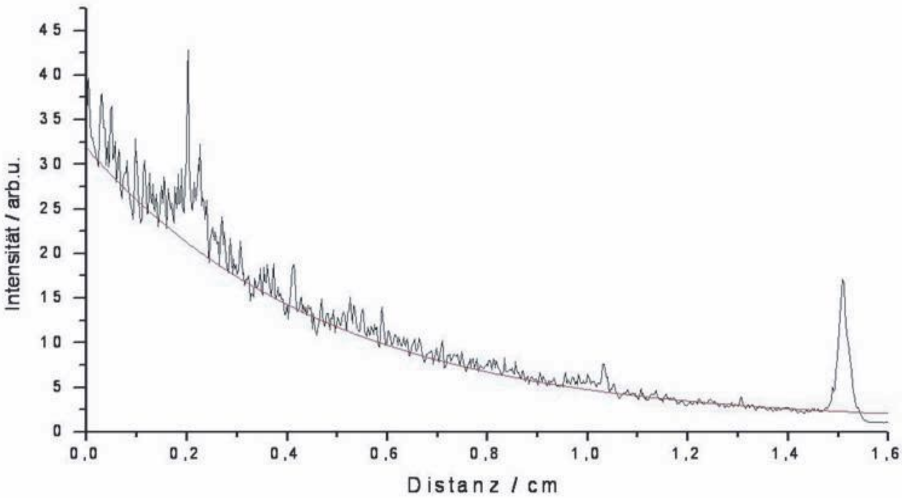


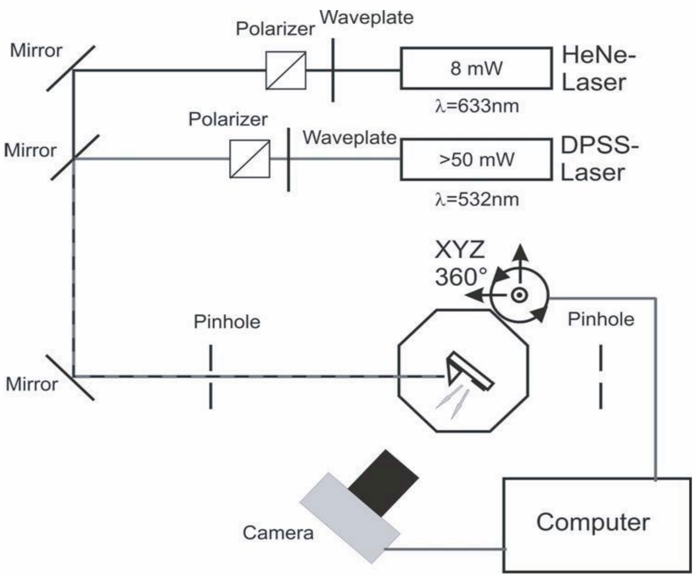


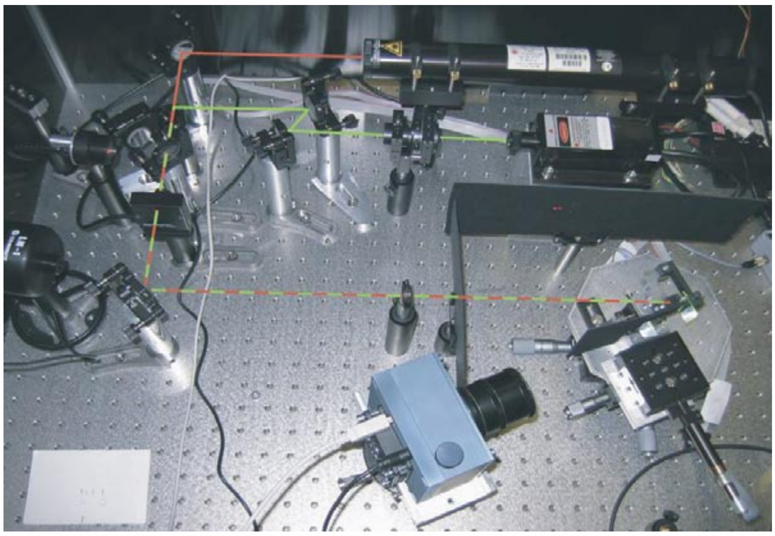
Streak caused by scattering inside the waveguide

Intensity distribution measured with CCD-Camera

The intensity distribution is detected with a computer controlled, cooled CCD-Camera. Finally the attenuation coefficient is extracted from the measured data.

The following two figures show the setup that was used for the measurements





Schematic of the Setup

Photography of the Setup

Additionally, it is possible with our setup to measure the refractive index and the thickness of waveguides that support a minimum of two guided modes. These parameters can be extracted from the dependency between coupling angle and effective refractive index.

1 M. Reufer, J. Feldmann, P. Rudati, A. Ruhl, D. Müller, K. Meerholz, C. Karnutsch, M. Gerken, and U. Lemmer, Appl. Phys. Lett. 86, 221102 (2005).

4119 Twilight Ridge, San Diego, CA 92130, USA Tel:: (858) 876-3133 Fax:: (858) 630-2376
E-mail:: sales@dmphotonics.com URL:: www.dmphotonics.com