Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

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Towards Mid-IR 3D Integrated Optics for Astronomical Devices.

ABSTRACT - Masterthesis

Direct detection of exoplanets is one of the flagship goals for the coming decades in modern astrophysics. Nulling-interferometry in the mid-IR waveband of 3.5-4.1 µm is one of the most promising techniques for the terrestrial direct detection of young planets. However, for the highest possible interferometric accuracy intricate three-dimensional optical waveguide circuits are required. A well-established technique for the fabrication of three-dimensional optical circuits is femtosecond laser direct-writing.

In this thesis the fabrication of single-mode waveguides in gallium lanthanum sulphide is investigated using 800 nm femtosecond lasers. An athermal and thermal fabrication regime is explored by using laser repetitions rates between 5.1 MHz and 1 kHz three different techniques are exploited to create circular waveguides: cumulative heating, multiscan and slit-beam shaping. The created structures are contrasted against each other in terms of physical size, mode-field diameters and losses. The losses are measured using the Fabry-Perot technique at 1.5 µm, whereas mode-field diameters are determined at 1.55 µm and 3.39 µm. Furthermore, the influence of thermal annealing on the inscribed structures is investigated.