Wavefront degradation during optical frequency conversion

Introduction

To reach UV wavelengths around 355 nm, laser systems are based on generation of IR radiation around 1064 µm (Nd:YAG) and then subsequent frequency-tripling. It is well known from these systems that the conversion efficiency of the nonlinear crystals decreases with time and exposure of the crystals. Thus, the systems are designed to change spot in the nonlinear crystals, when conversion efficiency has reached below a certain value.

For many applications, like laser direct imaging for photolithography not only the power is relevant, but also how the beam parameters and the beam aberrations evolve with time. Thus, this diploma work aims at investigating the beam parameter degradation and beam aberrations related to optical frequency conversion, as well as defining methods for characterizing the above mentioned beam properties.

Detailed description

1. Literature study on beam degradation. The purpose of this part is to identify the most relevant material degradations that lead to beam parameter degradations and aberrations. What are the reasons for the material degradation? What time constants are involved? What beam parameters are influenced by each specific form of material degradation?
2. Literature study on beam characterization. The purpose of this part is to identify different methods to characterize the degrading optical beam parameters and aberrations. Measurement of the beam's M^2 value is one method. What more methods are required to characterize the beam? It is of particular interest to identify prevailing degradation modes that can be addressed with specific compensation methods.
3. Design of experiment

   The next step is to do design an experiment to measure beam properties which were identified as the most common paths of degradation.
4. Experimental study

   If time allows, initial experiments will be performed.

Location

The diploma work will be performed in cooperation between Micronic Laser Systems AB and Department of Laser Physics at KTH. It is assumed that the initial parts of the work will be executed better at KTH, whereas the latter parts will be carried out at Micronic.

Supervisor

The supervisor at KTH and the formal examiner will be Prof. Fredrik Laurell. The supervisors at Micronic will be Jarek Luberek (Jarek.luberek@micronic.se) and Ulf Olin (ulf.olin@micronic.se).

Compensation
30000-51000 SEK depending on difficulty.

Desired time period for the work
It would be good if the diploma work could start before summer 2009 and finish in the autumn 2009.