University of Dayton
School of Engineering

Master's Thesis Defense
Electro-Optics and Photonics
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All are welcome to attend.

Nonlinear Microscopy Based on Femtosecond Fiber Laser

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Abstract

Nonlinear microscopy is an indispensable tool for biopsy and other kinds of sample detection, which can protect the sample from dye and redundant cutting. The penetration depth allows the detection of specific goals hidden under other coverage. If the sample is low melting point material, by using nanolithography to coat the sample with gold nanoparticles, it is feasible to do micro-dimension fabrication. We are going to present how to establish nonlinear microscopy theoretically and experimentally.

The nonlinear microscopy consists of three parts, microscope, light source and the optical beam path. The microscope setup is comprised of objective, the dichroic mirror, sample carrier stage and the detector. This microscope is scanning laser microscope (SLM). We are using linear scanning, scanning stage (LSSS) method and the carrier stage is a 2D motorized assembled stage. The nonlinear imaging principles are discussed and categorized. We choose potassium dihydrogen phosphate (KDP) as the sample to testify the feasibility of the nonlinear microscopy. Second harmonic generation (SHG) is the nonlinear signal used to reconstruct the shape of the sample.

For the light source, we are using all-normal-dispersion (ANDi) femtosecond fiber laser, whose pulse is around 100 femtosecond with 20 kW peak power. The self-started, compact femtosecond fiber laser provides stable and high peak power pulses. A short pulse is guided by the optical components onto the sample and generates second harmonic signal.

Keywords: Nonlinear imaging, ultrafast fiber laser.