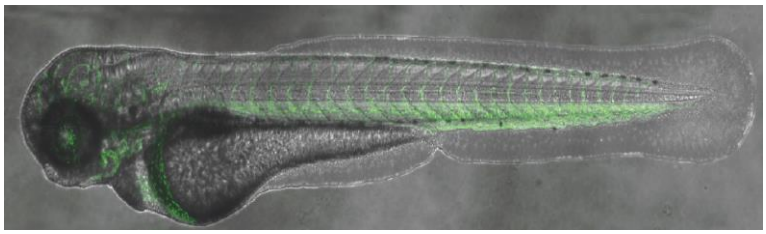
Thesis in the research focus

Invivo optical manipulation



Optical tweezers is an ingenious light-based device, which applies pico-Newton forces on artificial or living objects of nano or micrometer sizes. Thus, it enables trapping and manipulations of these particles in a versatile ways. Combining the ability to manipulate microparticles with force measurement, optical tweezers have been used to study the microrheological properties inside living cells. Literature shows that the motion of cells is influenced by the viscoelasticity of the cell and the surrounding tissue. This has been researched with special focus within living zebrafish embryo. One can observe cells moving through the tissue, meeting at a place to form new organs together there. This motion is of high interest due to its similarity to the migration of cancer cells. What makes cells move towards a certain point within a large, complex environment like a developing embryo?

Master's thesis (incl. professional specialization and project design))

Mapping the viscoelasticity in living zebrafish using optical tweezers

To determine biomechincal properties, Optical Tweezers (OT), implemented in an inverted microscope, will be employed. Through strong, biocompatible lasers (Infra Red), transparent and biocompatable particles that are included into cells can be moved contactless in different directions. With OT, these micro particles can be trapped inside the cells. These particles are used as handles to deform the cell membrane yielding data to obtain viscoelastic parameters of the cell. Due to the complexity of the living cell, sophisticated measurement protocols are required. These are known in literature and have been partially realized in our labs.

The goal of this Master thesis is to obtain quantitative rheological measurements in living cells in vivo and in vitro. Therefore, it encompasses training on the preparation, conduction and evaluation of measurements, programming analysis protocols (Matlab). Help and support by the supervisor will be granted on all related topics.

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Nonlinear photonics group

The Nonlinear Photonics group at the Institute of Applied Physics is headed by Prof. Dr. Cornelia Denz. With about 20 members we work in research and education on current problems in the field of optics of complex light fields for applications in nanophotonics, biophotonics and optofluidics, quantum optics, nonlinear optics and material production and investigation of optical materials, e.g. also with ultrashort laser pulses. Just contact us if you are interested in one of the following topics for your final thesis - whether for a Bachelor or Master Thesis.