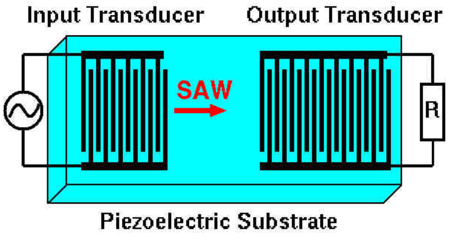
- 11803 Ultrasonic waves for sensing, filtering and data transmission
  Promotoren: prof. dr. ir. Jeroen Beeckman en dr. ir. Wouter Woestenborghs
  Begeleider(s): John Puthenparampil George
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:

  Piezo-electric materials are materials that deform when an electric field is applied. These materials are widely used in electronic components. In the latest smartphones (IPhone or Samsung Galaxy) these materials are used in so-called Bulk Acoustic Wave resonators (BAWs) for filtering in- and outgoing 4G signals. In other telecommunication techniques often Surface Acoustic Wave (SAW) resonators are used. In BAW resonators the waves travel perpendicular to the surfaces, in SAWs the waves travel along the surface. More info can be found on wikipedia.

  In the Liquid Crystals & Photonics research group a novel way to deposit high-quality thin films with extraordinarily high piezoelectric coefficients was developed (and patented). The deposition is optimized for optical applications, but this patented method could also be used for the fabrication of high quality SAW device. One particular advantage of our method is that the thin films can be deposited on very large substrates such as window glasses or glass surfaces in displays. In order to test the possibility to integrate such SAW devices on large area substrates and devices, in this thesis, SAWs will be integrated on glass substrates of about 10 to 20 cm. The ultrasonic waves will be generated by an input transducer and detected by an output transducer.

  Doelstelling:
  Depending on the interest and background of the student, this thesis will focus more on physical effects (diffraction & losses of the ultrasonic waves) or on applications (data transmission, sensors, ...). The basic scheme will be the same:
    - getting acquainted with piezoelectric materials: properties, measurements, deposition, ...
    - mask design: electrode design for the input/output SAWs
    - electrical measurements of the first tests samples
    - second design which will focus on either further study of the physical effects or the demonstration of an application
- 12070 Advanced electrical characterization of Kesterite thin film solar cells with different zinc and tin contents
  Promotoren: dr. Samira Khelifi en prof. dr. ir. Kristiaan Neyts
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:

  In thin film solar cells technology, the absorber is the layer where the majority of light is absorbed and converted to electricity. This is the reason why a large part of research is directed to the optimization of the absorber properties. Kesterite compounds (Cu_2ZnSnS_4 or $Cu_2ZnSnSe_4$) (CZTS) are good candidates to replace $Cu(In,Ga)Se_2$ (CIGSe) layer in thin film solar cells. The absorber layer of Kesterite thin film contains tin and zinc instead of indium and gallium, which are abundant, low cost and non toxic elements.

  The ratio between zinc and tin (Zn/Sn) has a big influence on the CZTS absorber layer properties and hence on the solar cell performance.

  Doelstelling:
  The aim of this thesis is to characterize CZTS thin film solar cells with different Zn/Sn ratio using advanced electrical characterization techniques to investigate the effect of Zn and Sn on the absorber physical properties.
- 11869 Characterisation of liquid crystal birefringence using magnetically induced alignment
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Oliver Willekens
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Liquid crystals are omnipresent in today's display market, but they are also of interest to telecommunication systems in e.g. optical phased arrays. These systems, because of their relatively large wavelengths compared to optical frequencies, require either extremely thick layers of liquid crystal or mixtures with high birefringence. The former reduces the speed at which signals can be switched and is therefor not preferred. The latter is a special domain in itself: it is not easy fabricating mixtures with high degrees of optical birefringence (0.2 being a normal value, 0.4 being on the high end).

  Material scientists who make these high birefringence liquid crystal mixtures need to characterize this birefringence accurately and rapidly. Current common techniques use a refractometer and optical filters, that result in very accurate measurements but they take up a lot of time. Moreover, the technique does not take into account the thickness of the liquid crystal layer which means there is no indication of an error of margin on these measurements. Finally, the measurements are only valid for the colors obtained with the filters. In between, the values get interpolated.

An alternative technique is to use the Fabry-PÃ©rot fringes in a transmission spectrum of the liquid crystal to derive the optical birefringence. This is fast technique that gives the results almost instantaneously for all wavelengths of interest. However, measurements have shown that for high birefringent liquid crystals, the thickness of the cell influences the measurement greatly. Taking into account the molecular shape of these liquid crystals, the technique can be optimized by using strong magnetic fields to align the liquid crystals.

Doelstelling:
In this master dissertation, you will have to study the effect of using strong magnetic fields to align liquid crystals in a cell (a 1 by 1 inch layer of liquid crystal sandwiched between 2 glass plates). You will have to create a setup that allows you to both apply these strong magnetic field and measure the transmission spectrum at the same time.

Initially, you will perform measurements on estimating the birefringence in cells, as a function of the cell thickness and as function of the mean molecular length. This means you will learn how to create cells yourself by cleaning and glueing substrates and filling them with liquid crystal.Â Thus, a large amount of cleanroom work is expected initially, but once that is done, the focus shifts to (very) experimental lab work.

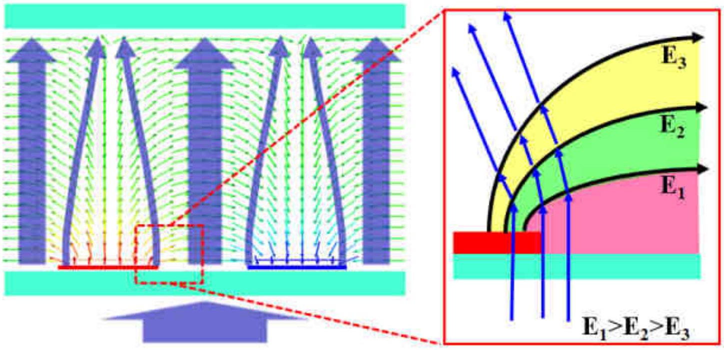
- 12074 Defect characterization in Cu(In, Ga)Se2 thin film solar cells
  Promotoren: dr. Samira Khelifi en prof. dr. ir. Jeroen Beeckman
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Thin film solar cells with Cu(In,Ga)Se2 absorbers have obtained quite high efficiencies up to 20% which is the highest efficiency obtained for any thin film cells. The role of defects in these compounds is of special importance because of the large number of possible intrinsic defects and the role of deep recombination centers in the performance of the solar cells. However, understanding defects in CIGS solar cells and correlating changes in the film formation process with differences in material properties, photovoltaic device performance and defects is a critical and challenging undertaking due to the structure complexity of this polycrystalline compound. Admittance spectroscopy (AS), among other capacitance-based techniques such as capacitance-voltage and Deep-level transient spectroscopy, is commonly used to characterize defects in photovoltaic materials.

  Doelstelling:
  The aim of this thesis is to characterize CIGSe thin film solar cells using different characterization techniques (capacitance-voltage, admittance spectroscopy, â?¦) to detect defects in these devices and correlate their presence with the electrical transport properties. Depending on the progress of the thesis and the specific interest of the student, modelling and simulation of the physical and electronic operation of these cells could also be performed using the software Scaps (Solar Cell Capacitance Simulator 1-D), a numerical simulation tool available freely to PV research community, developed at ELIS and mainly used for Cu(In,Ga)Se2 and CdTe based thin film solar cells.
- 11868 Design of an anisotropic ray tracer for liquid crystals
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Oliver Willekens en dr. ir. Wouter Woestenborghs
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Computer Aided Design (CAD) involves, among other things, the modelling and simulation of the functioning of a device for its respective field. These modelling and simulation tools also exist in the field of photonics (e.g. Zemax, COMSOL) and allow one to simulate the propagation of light in various geometries that represent the actual devices.

  The techniques used in these simulations can be categorized in a few groups, like finite differences and finite elements. Each has its own advantages and disadvantages. In our research group, we mostly work with the finite element method (FEM), because it allows one to increase the accuracy of a calculation in a region where one could expect the optical field to change drastically. It is therefore a computationally efficient method (computer power is given mostly to regions of interest) and is therefor fast. We have observed however that it does not always provide physical results when geometries are simulated that contain sharp corners in combination with anisotropic media. It would be of interest to find out not only why this is happening, but also to solve that problem.

Above is a figure taken from D. Xu et al., Optics Express 2013 in which an optical model is described to calculate light transmission through an anisotropic blue phase liquid crystal display.

Doelstelling:
In this master dissertation, you will create a computer program that simulates the propagation ofÂ light in anisotropic media, such as liquid crystals. The method will be similar to a ray tracer, but now applied for anisotropic media. Afterwards, you will verify the functioning of your simulation program by fabricating some liquid crystal cells (minor cleanroom work) and building a setup to measure the optical properties, such as deviation angle. Additionally you will be able to verify the validity of the method by comparing the result with some of the advanced finite element tools that are available in the research group.

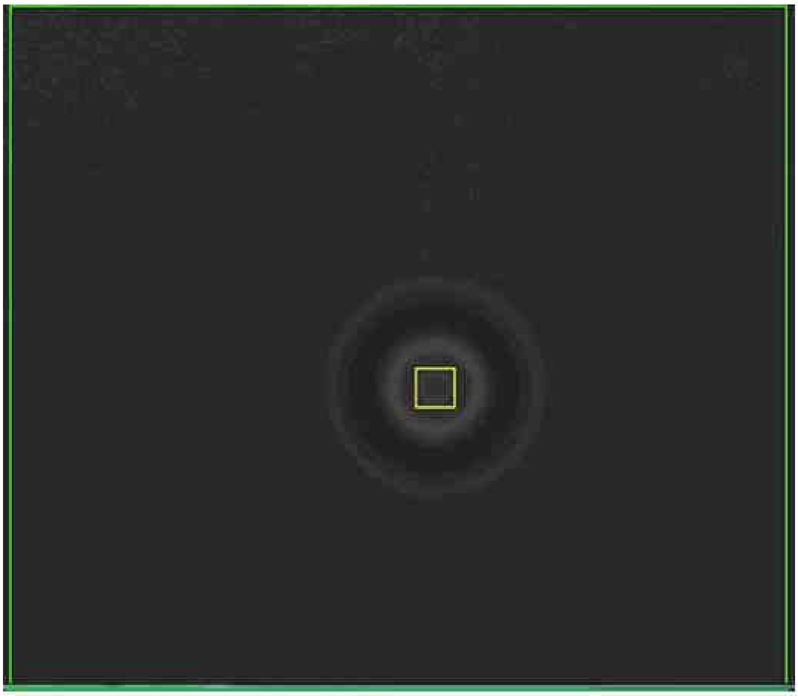
- 11708 Electrical characterization of electrophoretic inks
  Promotoren: prof. dr. ir. Filip Beunis en dr. Filip Strubbe
  Begeleider(s): Manoj Prasad
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

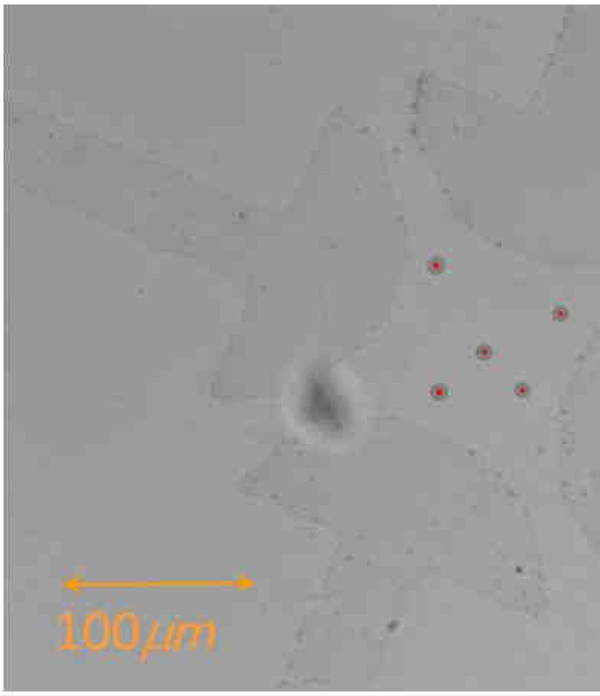
  Probleemstelling:
  Â
  Electrophoretic displays are based on the field-driven motion of toner particles in a liquid. To stabilize and electrically charge the toner particles surfactants are added. These surfactants however have an important influence on the electric field which in turn affects how the particle move in the display. Transient current measurements have been used in our group to accurately characterize many aspects of the effect of surfactant on the electric field. Only the long-term effects when voltages are applied for long times and a double peak in the current referred to as the â??camel problemâ?? are not well understood.

  Doelstelling:
  Â
  The aim of this Master thesis is to unravel two unexplained observations in the electrical behaviour of electrophoretic inks. The first one is the steady state current measured after applying a dc voltage for a very long time. This steady-state current originates from the continuous generation of charges in the liquid. Therefore the understanding of the steady-state current gives insight in this important generation mechanism. The second unexplained observation is a double peak in the transient current, which is related to charges that are adsorbed at the electrodes. To understand the physical mechanisms behind the experimental observations transient current measurements will be carried out. The experiments are then compared to a simulation model developed in Matlab.
  Â
- 11728 Electrical trapping of colloidal particles
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. Filip Strubbe
  Begeleider(s): ir. Caspar Schreuer
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

  Probleemstelling:
  Â
  Electrical trapping of particles is a useful tool for studying properties such as size, charge, shape, charging dynamics and refractive index of nano- and microparticles. The basic principle of electrical trapping is applying electrical fields to keep a single particle at a fixed 3-dimensional position. Alternately the trapped particle can be moved to a desired location to probe the interaction with an interface. So, in a first instance electrical trapping is useful to keep a single particle fixed such that its properties can be studied for a sufficiently long time. Oscillating electrical fields can then be superposed on the trap voltages to measure the electrical charge and the orientation of particles by the field. Simultaneous image analysis can be used to study the size, shape and refractive index. One of the big advantages of electrical trapping is that also fluorescent or scattering nanoparticles and absorbing pigment particles can by trapped which is difficult with optical trapping.
  Â





Doelstelling:
Â
The aim of this Master thesis is to electrically trap scattering and fluorescent nanoparticles using a device with electrodes in an octupole configuration. The device will be fabricated in the cleanroom of Zwijnaarde. The 3-dimensional position of single particles will be measure using a LabView based microscope setup. When the 3D particle position is known voltages are applied across the 8 electrodes of the octupole in real-time to send the particle to a desired location. Movies of electrically trapped particles, doubles and triplets will be analysed with Matlab software to determine the particle size, refractive index, shape, orientation and electrical charge. As a result the electrical trap can be used to accurately characterize inks for e-ink displays and liquid toner printers.

- 11735 Enhancing optical tweezers: trapping complex structures in complex media
  Promotoren: prof. dr. ir. Filip Beunis en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): Toon Brans en ir. Caspar Schreuer
  Richtingen: Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica

  Probleemstelling:

  Optical tweezers are a powerful instrument to examine micro-objects immersed in a fluid and are a widespread tool in various fields of research, ranging from molecular biology over fundamental cell research to colloidal science and nanotechnology. With these optical tweezers it is possible to hold a micro-particle in place and manipulate its position by only using a laser beam tightly focused by a microscope setup. Moreover, they allow for very sensitive force measurements to investigate various kinds of interactions between the micro-objects.

  The performance of the optical tweezers relies mainly on the quality of the diffraction-limited focus of the laser beam and on the intensity distribution of the light. Various aberrations, originating from the microscope optical components, the suspending fluid or the micro-object itself, deteriorate the beam quality and reduce the optical tweezers operation. The goal of this thesis is firstly to investigate novel ways to compensate for these aberrations by manipulating the phase front of the laser beam by means of a spatial light modulator (SLM). Secondly, this SLM will be used to generate arbitrary optical landscapes, enabling the trapping of complex cell structures.

  Doelstelling:
  This master project starts from an existing optical tweezing setup where a spatial light modulator is already introduced. The SLM creates a holographic image of the trapping beam using phase modulation of the beam. For this, various new algorithms will have to be developed and programmatically applied. Next, the algorithms will be used in a feedback loop resolving static and dynamic aberrations of the system. In a final step these algorithms will be used to generate optical landscapes, eventually resulting in the optical trapping of complex cell structures.

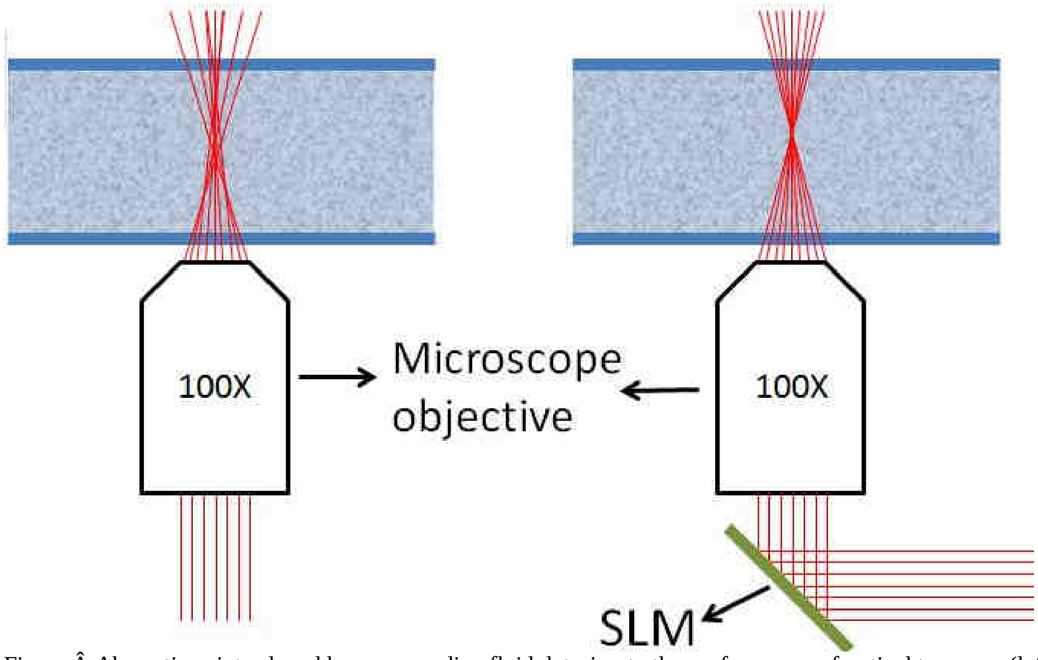
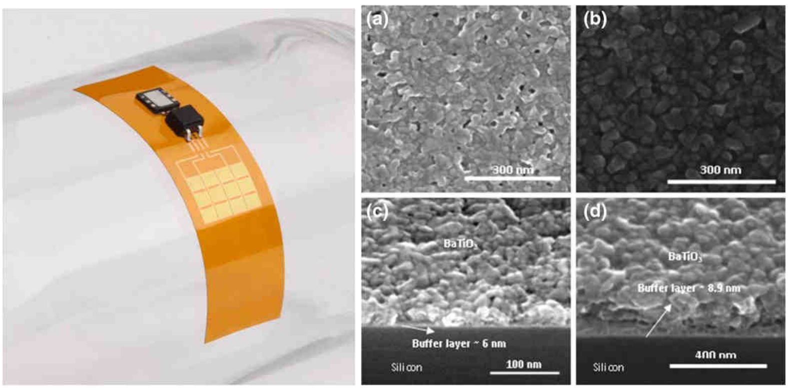


Figure:Â Aberrations introduced by a suspending fluid deteriorate the performance of optical tweezers (left). This master thesis uses a spatial light modulator (SLM) to compensate for these aberrations and create optical landscapes to trap complex cellular structures

- 11844 Flexible strain generator
Promotoren: prof. dr. ir. Jeroen Beeckman en dr. ir. Wouter Woestenborghs
Begeleider(s): John Puthenparampil George
Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Nowadays electronic systems are being embedded in different entities, such as the human body. These systems offer different novel applications and perform different sorts of tasks. Those systems require of course electric energy to function and they often rely on batteries, solar cells or are being supplied by an external source. More recent methods to harvest energy use piezoelectric materials. When a piezoelectric materials is deformed (strained) it generates a potential difference, which can be used to feed an electrical system. Its use to power a pacemaker was recently demonstrated. A picture of the piezoelectric device is shown below.



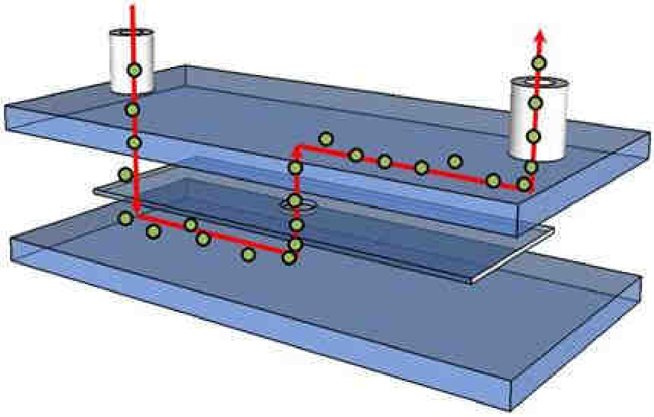
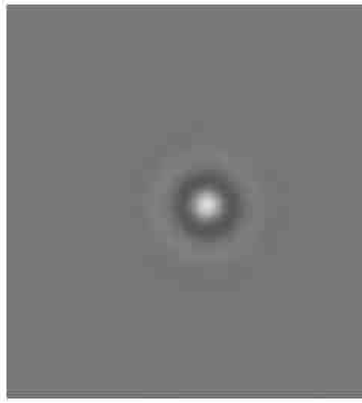
In the recent years the Liquid Crystal & Photonics research group has developed a novel method to deposit high quality piezoelectric layers (SEM images above). Currently the substrates on which the material is synthesized is typically Silicon or corning glass because it requires to withstand high temperatures in the process (~550Â°C). To create a device with the piezoelectric material which can be easily strained, a method needs to be developed to transfer the piezoelectric materials to a flexible substrate. For sufficient energy generation the piezoelectric materials will need to be structured, and etching techniques must be developed.

Doelstelling:

For this thesis the student requires to have an appetite and feeling for practical work. The scheme to approach this challenge consists of :

  - Getting acquainted with piezoelectric materials; learn our deposition and characterization methods
  - Learn clean room procedures and develop a process flow to transfer the piezoelectric materials to a flexible substrate
  - Develop a procedure to etch the piezoelectric material
  - Characterize the resulting strain generator

- 11684 High-throughput optical characterization of colloidal particles
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. Filip Strubbe
  Begeleider(s): ir. Stijn Vandewiele
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

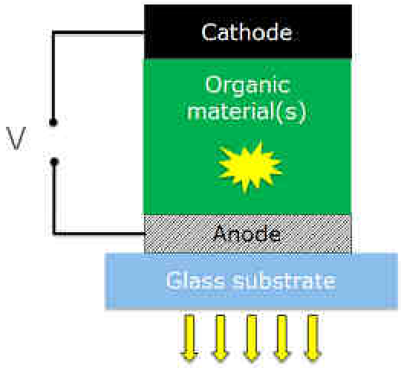
  Probleemstelling:
  Â
  Particle characterization is a necessity for a whole range of applications such as E-ink displays, liquid toner printers, pharmaceutical applications and bio-assays. The commercially existing methods to analyse such particles suffer from a number of short-comings: they are either not sensitive enough or lack the possibility to investigate multiple parameters (size, refractive index, shape, electrical charge). In our group a single-particle based analysis technique is developed which is both sensitive and versatile. Because currently the analysis of a particle sample still takes too much time, the method should become completely automated.
    

  Doelstelling:
  The aim of this Master thesis is fabricating a microfluidic device for high throughput analysis of liquid toners and inks for e-ink displays on a particle-to-particle basis. With this device a continuous flow of particles is sent through a vertical channel. Using optical microscopy and LabView software images of each particle are acquired at different positions with respect to the microscope focus. Image decomposition and analysis in Matlab then results in a unique â??optical fingerprintâ?? for each particle. These fingerprints hold information on the size, refractive index and shape of the particle. Depending on the preference of the student the focus of the thesis can be more on developing imaging software (LabView), analysis software (Matlab), fabricating microfluidics devices (cleanroom Zwijnaarde) or microscopy experiments (Technicum).
- 11777 Improving OLED display performance by means of a heat management system
  Promotor: prof. dr. ir. Kristiaan Neyts
  Begeleider(s): Frédérique Chesterman
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Barco is a global technology company that designs and develops visualization solutions for a variety of selected professional markets. One of these markets is medical imaging, for which Barco develops high-quality displays that help doctors to make the right decisions, thereby saving lives.
  LCD has been the main display technology in the medical imaging market for quite a few years now. OLED is a new emerging display technology with a few promising advantages with respect to LCD, such as an increased contrast, a larger color gamut, a wider viewing angle, a faster response time, low depth and weight and a potential for higher brightness and lower cost. Because of this high potential, OLED will become a competitor for LCD in the near future.

  However, before OLED can become a competitor for LCD in the medical imaging market, a few remaining challenges need to be tackled. One of the main issues that OLED displays currently suffer from is a limited lifetime because of degradation of the organic material. This effect is closely related to the displayâ??s temperature. Indeed, the degradation of the OLED material is accelerated at high temperatures. Moreover, non-uniform temperature across the display can cause local degradation acceleration resulting in non-uniform images over time. As such non-uniformity is undesirable for medical applications, it is clear that thermal control of the display is indispensable.

  Barco insists on careful guidance of thesis students as reaching good results is both in the studentâ??s and in Barcoâ??s interest. In the past, thesis positions have regularly led to a permanent position at Barco.



Doelstelling:
The student working on this master thesis will participate in a project aiming at developing a heat management system for an OLED display. This will encompass a few different tasks.

A first part of the studentâ??s work is related to investigating the link between the OLED emission and its thermal behavior. This part is mainly theoretical and encompasses describing the physical link between the processes that take place inside the OLED and its heat creation and coupled to that a study on the efficiency of different cooling mechanisms and other relevant parts of the heat management system. Furthermore, this task encompasses investigating the potential benefit of thermal control, i.e. its impact on the display characteristics.

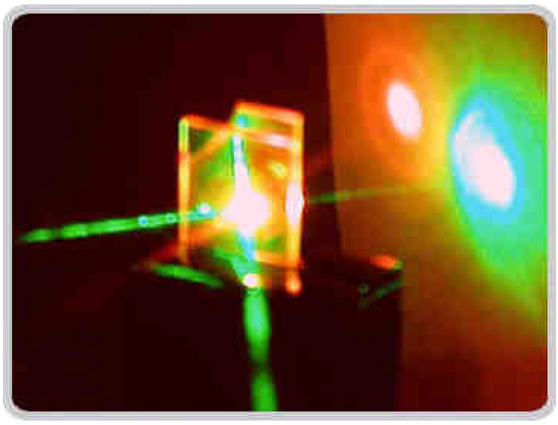
An essential part in the design of a heat management system is performing simulations as such simulations allow tuning the parameters of a specific solution and also validating its performance. Â The second part of the studentâ??s work is developing a thermal simulation model for a heat management system. This incorporates inclusion of a basic OLED panel into the model as well as a number of specific additional components which are part of the heat management system. The model should be created in such a way that it can serve as a useful tool for the designer of a heat management system. This means e.g. that the model should be made generic so that it can be used for the simulation of different OLED technologies. It should also be possible to easily tune the different parameters of the model and the simulation results should be presented in a clear way to the designer. The thermal model will be created on a commercially available thermal simulation platform. On top of the thermal characteristics, also the impact of the different optical components (which are part of the heat management system) on the display characteristics would have to be examined.

A last part of this thesis consists of performing optical and thermal measurements on a prototype OLED display with a heat management system, and comparing the results with what is obtained through simulation. This will allow verifying the performance of the model and will also give an idea on the precision that is required for such a model.

An important remark to take into account is that the solutions developed in the project in which the student will participate are developed at Barco and are property of Barco. This means the student wonâ??t participate in the invention process itself.

- 11319 Liquid crystal lasers with enhanced output power by amplification
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Inge Nys en Serena Bolis
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Liquid crystals (LCs) can be used for many other applications outside their use in LCD-displays. One novel use of LCs is to make lasers by incorporating light emitting materials inside the LC. The reflection interfaces required to achieve lasing are made by twisting the liquid crystal molecules with the right periodicity to achieve a Bragg-like mirror. Advantages of the liquid crystal laser are that their emission wavelength can be tuned over a wide range and that they are much easier to fabricate than other microcavity lasers such as VCSELs. However challenges still remain in decreasing the lasing threshold and increasing the maximum output power.



Recently it was shown that a nematic liquid crystal cell can be used to amplify the signal of a liquid crystal laser. By combining a liquid crystal laser and amplifier in a single cell the total output power could be substantially increased.

Doelstelling:
The aim of this thesis is to design and fabricate a liquid crystal laser with enhanced output power. This will be done by incorporating a liquid crystal amplifier layer on top of the CLC laser film.

The project consists of a fabrication part and an experimental part. First a process for creating a polymerized CLC laser film will be developed. Afterwards the polymer laser will be incorporated in a liquid crystal cell filled with the dye doped â??amplifierâ?? liquid crystal.

The processing of liquid crystals will be done in the liquid crystal process bay in the clean room in Zwijnaarde. The fabricated cells will be characterized in the labs at the Technicum. The spectrum, laser threshold and output power will be characterized. A setup for bi-directional pumping of the fabricated cells will be designed and optimized for these measurements.

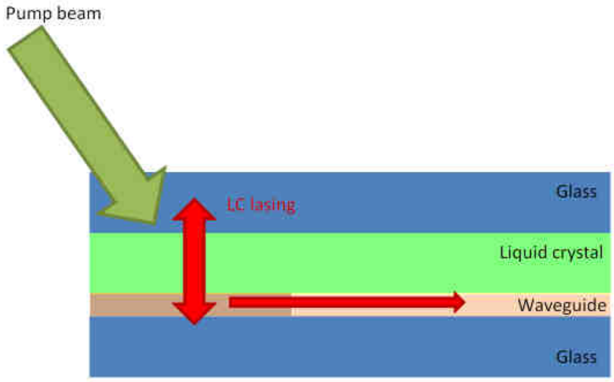
- 11321 Liquid crystal lasers with waveguide coupling
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): Mohammad Mohammadimasoudi en ir. Inge Nys
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Lasing in liquid crystals is quite easy to achieve because of two reasons:
    - Liquid crystals can have optical gain by mixing appropriate laser dyes into the material
    - Building and designing a cavity for optical feedback is not necessary, because the optical feedback can occur inside the material itself. The liquid crystal is doped with a chiral dopant which introduces a periodic pattern in the liquid crystal: the liquid crystal molecules twist and form a helix. This gives a reflection band for certain wavelengths

  When the gain spectrum of the dye is matched with the reflection band of the liquid crystal, the material can start lasing when it is sufficiently pumped.Â Last year, two master thesis students have been working on two different subjects: one was working on the improvement of the efficiency of such lasers by introducing a defect mode. The other student was working on liquid crystals as gain medium for optical signals.

  The subject of liquid crystal lasers is a hot topic in research. Some time ago, a review article on liquid crystal lasers appeared in Nature Photonics.

  Doelstelling:
  In this thesis, we want to investigate the possibility to couple the laser light efficiently into a waveguide structure. Currently, most of the research is focused on the use of these lasers for free-space applications (e.g. for cheap tunable laser sources, for use in projection systems, etc.), but we think that these lasers have a lot of potential when the light can be efficiently coupled into a waveguide structure. The aim of this thesis is to fabricate a coupling structure to couple the light into the waveguide. Most probably this will be done by writing a grating into a polymer waveguide with the holographic UV laser setup which is available in the research group. Then the liquid crystal laser has to be put onto this coupling structure and the lasing and coupling will be tested experimentally. A small optical setup will be built for the experiment.



Depending on the interest of the student, this subject can be modified.

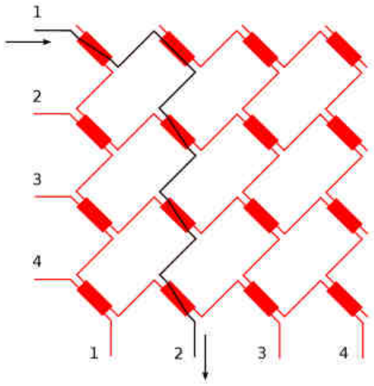
- 11881 Liquid crystal lasers: study of the optical reorientational effect on the lasing mode
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. Pascal Kockaert [Université Libre de Bruxelles]
  Begeleider(s): Serena Bolis
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Cholesteric liquid crystals (CLC) are molecules that spontaneously dispose themselves in a one dimensional periodic structure, creating an optical band-gap where the light is reflected. Mixing a laser dye in this material that emits in the same range, we obtain stimulated emission in a distributed feedback structure leading to laser emission. Moreover liquid crystals can be reoriented by electric fields, like the optical electric field of a laser beam. This reorientation can influence the laser mode emission: in the center of the pump beam the molecules can be reoriented forcing the laser emission on a ring pattern.

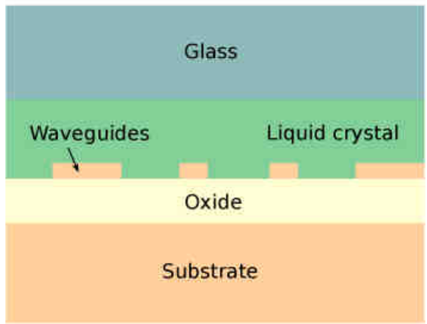
  Doelstelling:
  The first part of the work will be the fabrication of the LC cell in the UGent cleanroom. The second part will be a continuation a previous Master thesis, where a threshold has been observed above which the molecules staid reoriented if the pump was switched off abruptly, but they could restore their initial position if the pump power was slowly decreased. This â??optical treatmentâ?? can be thought in analogy with the thermal treatment in metallurgy: if the material is rapidly cooled down, it is possible to freeze the defects in the crystalline structure, while if the temperature is slowly decreased the material has the time to reorganize itself in a regular structure.
  The objective of the Master thesis is twofold:
  - identify the origin of this stable deformation of the CLC, from a fundamental point of view;
  - identify the parameters that determine the maximum output power of the liquid crystal lasers, with the aim to improve their performances.

  The study of the molecular organization will be carried out analyzing the modification of the probe beam polarization transmitted by the cell. The spectrum and the polarization of the laser emission will be studied as function of the structural modification of the system. The comparison of the behavior of different dyes can be considered.
- 11790 Low power optical switch fabric by liquid crystal integration
  Promotoren: prof. dr. ir. Dries Van Thourhout en prof. dr. ir. Jeroen Beeckman
  Begeleider(s): Herbert D'Heer
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Today in central offices there are a huge number of optical fiber connections. One of the attempts to automate these connections are MEMS based switching devices. The size of these devices, however, is large and they are prone to mechanical vibrations. On top of that the power consumption is not negligible (in the order of tens of Watts for a 300x300 switch). Instead, realizing optical switches in silicon photonics technology has many advantages, such as a substantial reduction in device size and stability to mechanical vibrations. In silicon photonics tuning of components is typically done by the thermo-optic effect. For a large number of switch elements, which each would require a heating element, the power consumption still remains too high. Integrating the chips with liquid crystals eliminates this problem and because of the large anisotropy of the liquid crystal the performance of the switch can be improved. The integration of both technologies is demonstrated by the Photonics Research Group and the Liquid Crystals and Photonics Group, but up to now only for individual components such as ring resonators. Combining the advantages of both material platforms to make a switch circuit has never been done before. Because these switches will potentially be used in telecom applications broad wavelength operation needs to be taken into account during the design. This work fits in the context of the European project SWIFT.



Example layout of 4x4 switch



Liquid crystal on silicon waveguide

Doelstelling:
In this thesis you will develop a low power integrated switch fabric by combining liquid crystals and silicon photonics. You will validate the concept by realizing a 4x4 switch, which operates over a broad wavelength range. The switch will be designed using various software tools. The circuit layout of the designed switches will be send to imec, which will provide the silicon chip. Integration of the LC and the silicon chip will be partially done in the cleanroom facilities in Zwijnaarde. After fabrication you will characterize the performance of the designed switch.

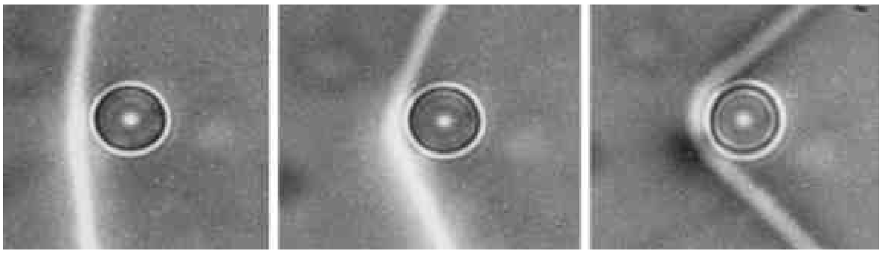
Group websites:
http://photonics.intec.ugent.be
http://lcp.elis.ugent.be

- 11318 Manipulation of liquid crystal domains using optical trapping
Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Filip Beunis
Begeleider(s): Glenn Mangelinckx en ir. Caspar Schreuer
Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Liquid crystals can be found in most displays thanks to their excellent colour properties. Other technologies however dominate the market of ultra low power consumption devices such as eâ??readers. Due to their power hungry driving process, regular liquid crystal displays are unsuitable for the eâ??reader market. This issue inspires the use of bistable liquid crystal devices and the hereunder proposed research.

Using standard and cheap production processes, liquid crystal devices exhibiting *metastable* behaviour can be made. This can for instance be seen in the bottom left figure. As illustrated on the figure, metastable domains disappear when they are in contact with a lower energy domain. The challenge for the student is to â??fixâ?? these domain boundaries by introducing suitable particles into the liquid crystal. This phenomenon may occur if the elastic energy at the boundary between two domains is sufficiently lowered by the presence of the particle(s). Another suitable option is the use of particles with a repelling instead of attracting nature (see bottom right figure).

If appropriate *mobile particles* are added to the liquid crystal, their position can be manipulated using an optical trap. By steering multiple traps, quasi-arbitrary domain shapes can be adjusted in real time.



Doelstelling:

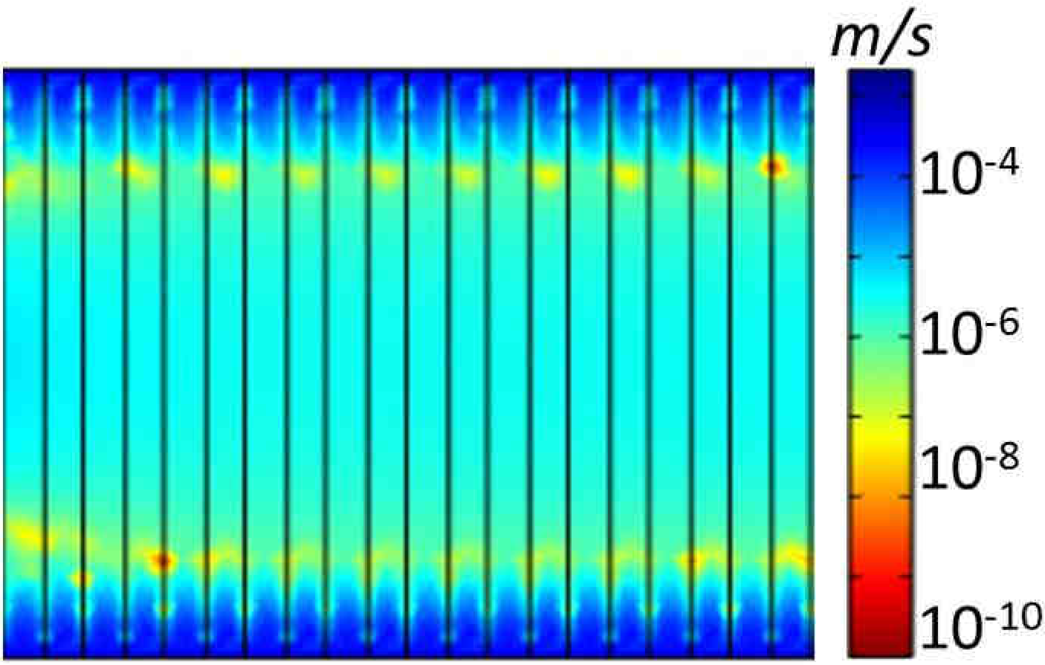
The studentâ??s final goal will be to create a bistable liquid crystal device of which the domains have an arbitrary shape which is adaptable in real time by means of optical trapping. In order to achieve this goal, the student will first gather the necessary theoretical and practical knowledge about liquid crystals:

- Familiarization with liquid crystal basics (theory, simulation, fabrication in clean room) and with measurement of liquid crystal properties
- Metastability in liquid crystals: switching to a metastable state and the behaviour of domain boundaries (theory, simulation and experiment)
- Introducing particles in liquid crystals: topological defects, fixing domain boundaries
- Optical trapping of microparticles in liquid crystal: defining domain shapes before switching the liquid crystal to the metastable state followed by real-time adjustment

- 11804 Microfluidics for Optical Trapping Electrophoresis
Promotoren: prof. dr. ir. Filip Beunis en dr. Filip Strubbe
Begeleider(s): ir. Caspar Schreuer en Toon Brans
Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Most lab-on-a-chip systems have a microfluidic channel to study dispersed particles. A common issue in microfluidics is electro-osmotic flow, for instance in optical trapping electrophoresis, a recently developed method to accurately measure the charge of a single particle. The presence of an electric field induces a fluid flow, which disturbs measurements on a dispersed particle. The origin of this flow lies at the finite surface charge of the channel, which attracts free moving ions of the opposite polarity. By applying an electric field, this layer of ions starts moving and it drags the fluid in the bulk along.

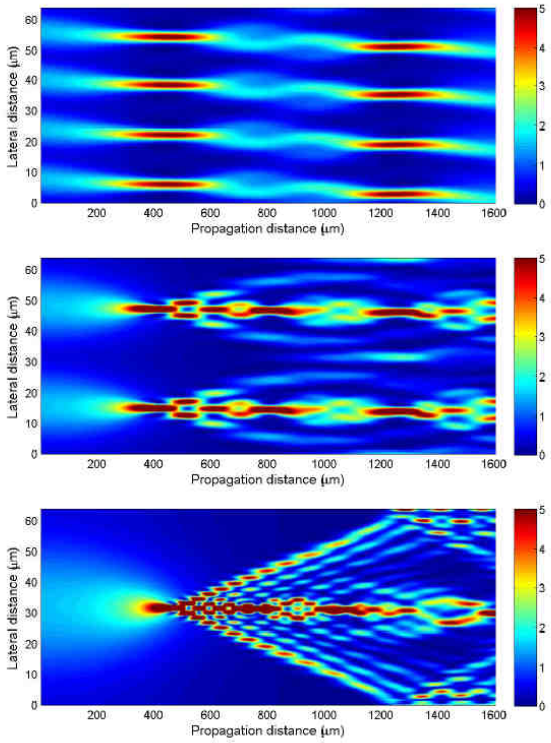
Doelstelling:
A novel approach to counter this flow is to design the surface of the channel to have an alternating pattern of strips with positive and negative surface charge. Each two neighboring strips direct a flow in the opposite direction, effectively cancelling each other out. As a result, the bulk of the channel is flow free.



This thesis includes simulating a microfluidic channel, has a technological aspect in manufacturing the designed microfluidic device and a hands on part in which you will perform your own measurements with the optical trap. Furthermore, this thesis fits in a bigger project, in which the LCP-group develops a new technique to study charging mechanisms of particles in water.

- 11323 Modulation instability with gain nonlinearity
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. Pascal Kockaert [Université Libre de Bruxelles]
  Begeleider(s): Serena Bolis
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Modulation instability (MI) is a universal effect existing in many nonlinear systems and has been studied in a wide range of fields including fluid dynamics, plasma physics and nonlinear optics. It means that perturbations of the plane wave solution will get amplified along the propagation direction. The explanation of this phenomenon is the energy transfer between spectral modes, namely between the zero-order mode (the plane wave) and higher-order Fourier components in the signal. When adding a sinusoidal perturbation, this perturbation gets amplified and under certain circumstances, after some propagation distance, the perturbation decreases again and the system returns to its initial state. This phenomenon was first reported by Fermi, Pasta and Ulam and is nowadays commonly called FPU recurrence. The figure below shows simulations of such a nonlinear system. The initial sinusoidal perturbation is initially amplified. After reaching the maximum amplification, the system can go back to to the initial state or alternatively, it can lead to quite complex behavior.



Modeling and experimental demonstration of modulation instability, induced modulation instability and recurrence has been done for materials with optical nonlinearities. In this thesis, the purpose is to extend the model and/or provide experimental evidence that modulation instability also occurs in materials without optical nonlinearity but with optical gain. Optical gain (e.g. due to stimulated emission) is also a form of nonlinearity.

Doelstelling:
Depending on the interest of the student, the focus of the thesis can be devoted more to theoretical work or more to experimental work. This means that the thesis may consist of the following tasks:

Theory
- Calculation of modulation instability for optical gain nonlinearity. Determination of the gain coefficient and frequency with maximum gain.
- Investigation of the effect of deviations from pure gain: effect of saturability, etc

Experimental verification

- Devices need to be prepared with strong optical gain. These devices will be fabricated in the clean room in Zwijnaarde.
- Building an experimental setup including a pump laser to excite the laser dyes, a signal beam which will be amplified and an imaging system.
- Comparison with theoretical calculations

References:

[1] J. Beeckman, K. Neyts, and M. Haelterman, "Induced modulation instability and recurrence in nonlocal nonlinear media," J. Phys. B: At. Mol. Opt. Phys. 41, 065402-065402 (2008).

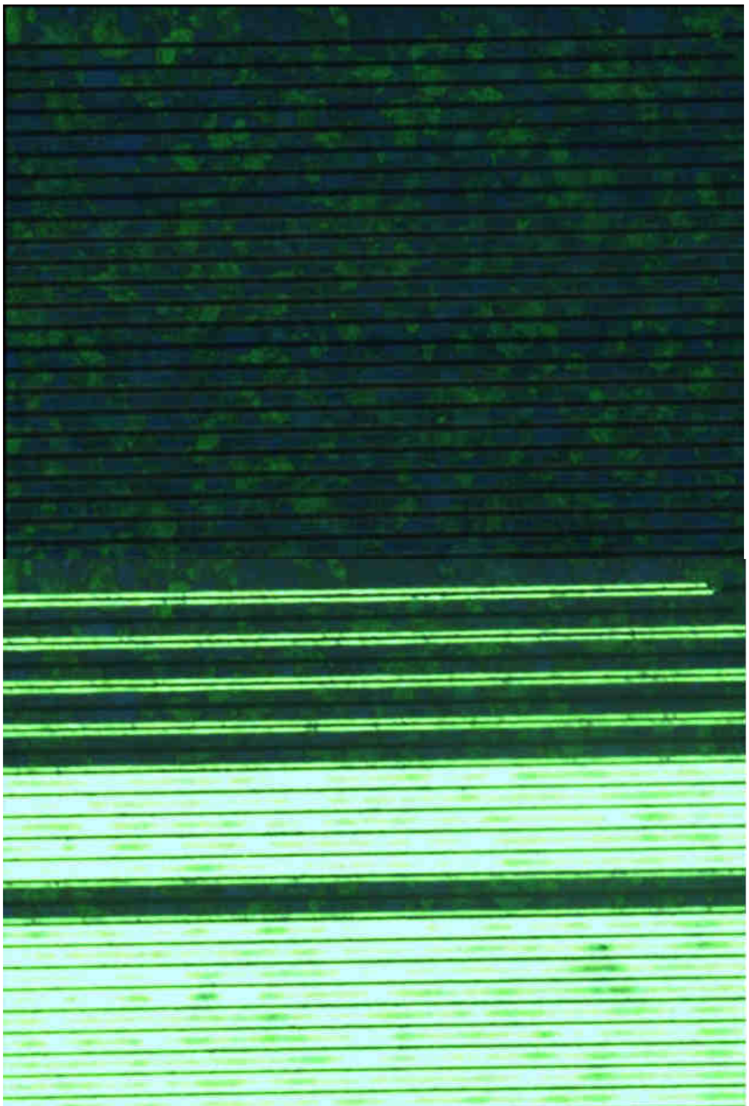
[2] N. N. Akhmediev, "DÃ©ja vu in optics," Nature 413, 267-268 (2001)

- 11867 Monodomain blue phase liquid crystals for the next generation of displays
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Oliver Willekens
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Liquid crystals are the dominant technology in modern displays. In recent years, scientists have been studying a special type of liquid crystal, known as the "blue phase" liquid crystal which is receiving a lot of attention, because it has switching times (the time needed to "rotate" the liquid crystal such that it goes from a dark state to a bright state) on the order of tenths of milliseconds and is largely polarization independent. Prototypes of blue phase displays have been demonstrated. Below is a prototype presented by Samsung some years ago.

  Because of these features, it is turning heads in 3D display markets and projection systems. But not a whole lot about this mesophase is known; a lot of the times assumptions are made. In this topic, you will perform scientific experiments to broaden the accepted knowledge on the blue phase. Below is a picture of a blue phase liquid crystal in which the platelets are nicely visible. A video when the cell is switched using interdigitated electrodes can be found here.

  Doelstelling:

In this master dissertation, you will first investigate the available options to produce large mono-domain blue phase liquid crystal cells.You will need to apply these techniques (improving on them as you experiment) in order to obtain a cell (a 1 by 1 inch layer of liquid crystal sandwiched between 2 glass plates) in which the blue phase crystal structure is largely ordered in just 1 specific direction, resulting in a large and uniform area ("a single, large platelet").
In the second step, you will use these self-fabricated cells to measure the anisotropic dielectric properties and to compare them to the (usually well-known) dielectric properties of the host liquid crystal.
Finally, you will do the same for the optical properties, which can be considered an extension to the dielectric properties (understanding of one, will lead to a better understanding of the other).

A large amount of cleanroom work is to be expected: you will learn how to spincoat alignment layers, clean substrates, and glue them together to create cells needed for your research. In the lab, you will mostly be working with devices designed to measure capacitances at different frequencies and the polarizing optical microscope.

- 11802 OLEDs: Help shape the technology of tomorrow!
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. ir. Wouter Woestenborghs
  Begeleider(s): ir. Michiel Callens
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:

  Organic Light Emitting Diodes (OLEDs) are an exciting and rapidly developing technology. They are revolutionizing the display market, showing unprecedentedÂ colourÂ rendering and contrast.
  Besides this these OLEDs can also be made flexible and even transparent! This is truly the technology of tomorrow! The most exciting thing, from a research perspective, is that this is a relatively new field and there is still plenty of room for improvement. If you are interested in a thesis subject that strikes an excellent balance between theoretically interesting research and practically relevant work, this is something for you.

  One of the places where there is lots of room for improvement is trying to find new and better ways to extract the light from within these OLED structures, where it is partly trapped due to internal reflections. This will be the subject of this thesis. We have a number of ideas on this, but the aim here is to have a very flexible thesis subject that can go in the direction you feel most passionate about.Â

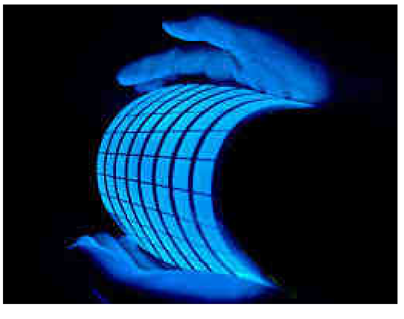
  

  Figure 1: Example of a flexible OLED substrate.

Figure 2: Example of a OLED display. These OLED displays show unprecedented colour rendering and contrast. In addition to this these displays can be made extremely thin.

Doelstelling:

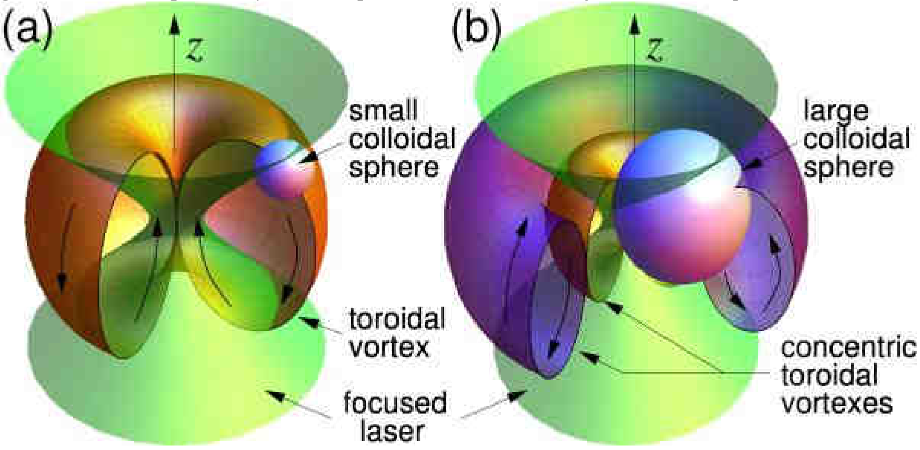
In this thesis we encourage the student to work together closely with people in our group and work on simulations and/or fabrication of OLEDs with increased out-coupling.
We leave it to the student to decide where he/she wants to put the emphasis in this and will guide them in this. We have in-house-built software to simulate OLEDs with
internally structured layers as well as a software package to simulate anisotropic layers in OLEDs. You will also have access to the cleanroom in Zwijnaarde where we
have the facilities to do fabrication. Â

The eventual goal is to develop a new technique to increase out-coupling efficiency from OLEDS or improve upon an existing one. This can be based purely on simulations or can include an elementÂ of fabrication in combination with simulations.Â

Please do not hesitate to contact Michiel Callens (michiel.callens@elis.ugent.be) should you want more information or some literature.

- 11801 Optical forces in non-Gaussian beams
  Promotoren: prof. dr. ir. Filip Beunis en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Caspar Schreuer en Toon Brans
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Optical tweezers are used for characterizing micrometer sized particles in fluids. They hold particlesÂ in a fixed position in the fluid, allowing very accurate measurements. Optical tweezers consists of a tightlyÂ focused laser beam. Particles with high refractive index are attracted to the focus and trapped atÂ this position. The source of this â??classicalâ?? trap is the intensity gradient of the beam; the particle isÂ attracted towards the region with the highest optical density. Recently, attention has been drawnÂ to developing new types of traps that are non-Gaussian. In the LCP group, we have built a setupÂ that can transform an incident Gaussian beam into any type of beam or trap. This opens a lot ofÂ possibilities, such as Laguerre-Gaussians, Bessel beams, optical solenoid beams, phase-gradientÂ line traps, etcâ?¦ These traps increase the accuracy of the technique and extend it to a new class ofÂ experiments.



  Doelstelling:
  Non-Gaussian beams have complex phase profiles and intensity distributions. These tailored trapsÂ offer stronger traps and more accurate detection beams. The extra degrees of freedom allow toÂ exert a torque on colloidal particles, to trap low and high index materials or even to apply a force that isÂ directed opposite to the beam propagation. Using the existing setup, you will address the spatial lightÂ modulator (SLM) and generate the desired optical trap. This project involves calculating the requiredÂ SLM pattern with a (partially self-written) program and performing the measurements with beamÂ patterns you designed.
- 11870 Optically tunable in-plane laser
  Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. ir. Kristiaan Neyts
  Begeleider(s): ir. Oliver Willekens en ir. Inge Nys
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  An in-plane (liquid crystal) laser is a stack of 2 substrates with a liquid crystal sandwiched between them. This liquid crystal (LC) has to have similar properties like common balpoint lasers, such as a gain medium and reflectors to build up the resonance needed for lasing. Chiral nematic liquid crystals are ideal for this application, because they have properties similar to that of mirrors and thus fulfill one of these 2 lasing requirements. However, this LC, which could be thought of as a helix, needs to be placed in an unconventional way: its helical axis should be parallel to the 2 substrates, not perpendicular to it. Inducing this alignment cannot be done with the conventional method of "rubbing", a technique used to give the molecules a preferential orientation by gently rubbing the surface of pre-treated substrates with a soft cloth.

  A modern alternative to rubbing is to use photoalignment, in which a spincoated material is only illuminated with polarized light to induce this preferential direction. This technique is very well suited for in-plane lasing, because it is now possible to design microscopically small domains with varying preferential orientation with relative ease using holographic techniques, like interference of 2 laser beams.

  Doelstelling:
  In this master dissertation you will fabricate an optically tunable in-plane laser, using a holographic alignment pattern written to a photoalignment layer. It should be possible to rewrite this pattern to tweak the lasing wavelength up to a few nm, depending on the illumination angle of the interfering beams and the gain spectrum of the used dye.

- 11739 Photonic force microscopy
  Promotoren: prof. dr. ir. Filip Beunis en prof. dr. ir. Kristiaan Neyts

Begeleider(s): Toon Brans en ir. Caspar Schreuer
Richtingen: Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in de ingenieurswetenschappen: fotonica

Probleemstelling:
Atomic force microscopy, first implemented in 1986, is a scanning force microscopy technique with which resolutions smaller than a nanometer can be achieved. It has proven to be a very powerful method, but is limited to probing surfaces. Photonic force microscopy is an innovative variation of the same principle, in which optical tweezers are used instead of a cantilever, and which is not limited to surfaces. The principle behind optical tweezers is that an object with a higher refractive index than the surrounding liquid is attracted towards the focus of a tightly focused laser beam. For a spherical microparticle, this force can be very well characterized. If another, unknown force is also acting on the particle, its equilibrium position will slightly shift away from the focus. By measuring the displacement of the particle, the unknown force can very accurately be determined. By scanning the particle along a surface, in the vicinity of another object, or just in the bulk of a liquid, a detailed three dimensional force landscape can be obtained.

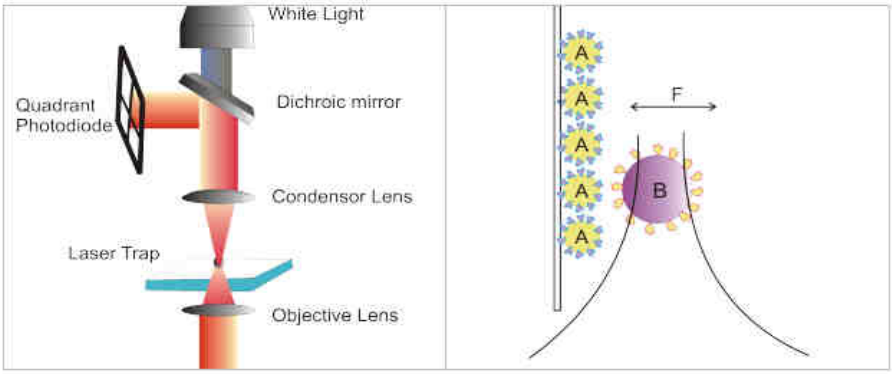


Figure: Schematic representation of the implementation and principle of photonic force microscopy

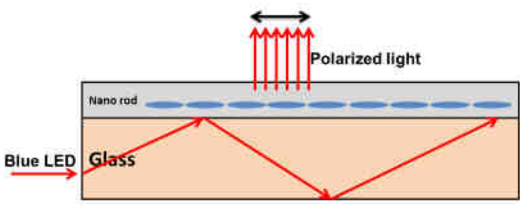
Doelstelling:
The â??Liquid Crystals and Photonicsâ?? (LCP) Group has built a double optical tweezers and accurate position detection setup, around a state-of-the-art confocal fluorescence microscope. We have already demonstrated that we can measure charge with a resolution better than the electron charge with this setup (see e.g. http://physics.aps.org/articles/v5/3). In this master thesis project, we want to extend the possibilities of our setup to photonic force microscopy. We will primarily focus on the measurement of electrical forces, to accurately map the charge distribution on surfaces or objects in a solution. To achieve this, charged microparticles will be used as a probe for the electric force. Your goal will be to implement this technique on our setup, characterize and calibrate the optical force on the charged microparticle probe, and demonstrate photonic force microscopy in a number of different situations. This is an ambitious project, which includes technological, experimental and theoretical work. Â

- 11997 Polarized LCD backlight using aligned nanorods
Promotoren: prof. dr. ir. Kristiaan Neyts en prof. dr. ir. Jeroen Beeckman
Begeleider(s): Mohammad Mohammadimasoudi
Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:

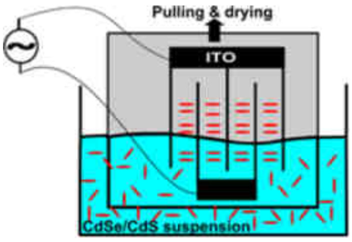
The optical efficiency of color LCDs is notoriously low. Of every lumen of light generated in the backlight, only 2â??8% is used owing to light losses in polarizers, color filters, and other optical layers. We propose a novel method to create a polarized backlight without using polarizer which can increase the efficiency by a factor two.

Semiconductor nanorods mainly absorb and emit light with the electric field along the axis of the rods. It is therefore important to align the nanorods along a preferred direction. The homogeneous deposition of aligned nanorods on large substrates is interesting for large size applications such as solar cells and OLEDs. In this work, we present a fast and versatile method for the homogeneous deposition and alignment of nanorods from a colloidal suspension. The method is based on a low-cost dip-coating procedure during which an alternating electric field is applied. A polarized light can be observed with coupleÂ blue light in a nanorod substrate.



Doelstelling:

In this thesis, we want to investigate the possibility to make a polarized backlight with aligned nano-rods. After simulations, part of the fabrication should be carried out in the clean room at Zwijaarde and the optical experiments will be performed in the labs of the Liquid Crystals & Photonics group. The accumulation, orientation, and polarized fluorescence of the nanorods should be verified by AFM or polarized Â fluorescence microscopy.

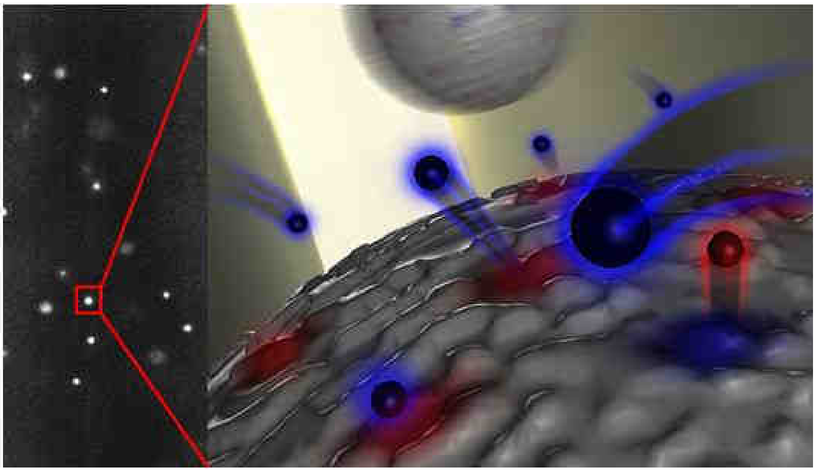


A sketch of the experimental setup: a glass substrate with interdigitated ITO electrodes is pulled out of a colloid suspension in the presence of an electric field.

- 11705 Quantized charge measurements of colloidal particles
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. Filip Strubbe
  Begeleider(s): Oksana Drobchak
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

  Probleemstelling:

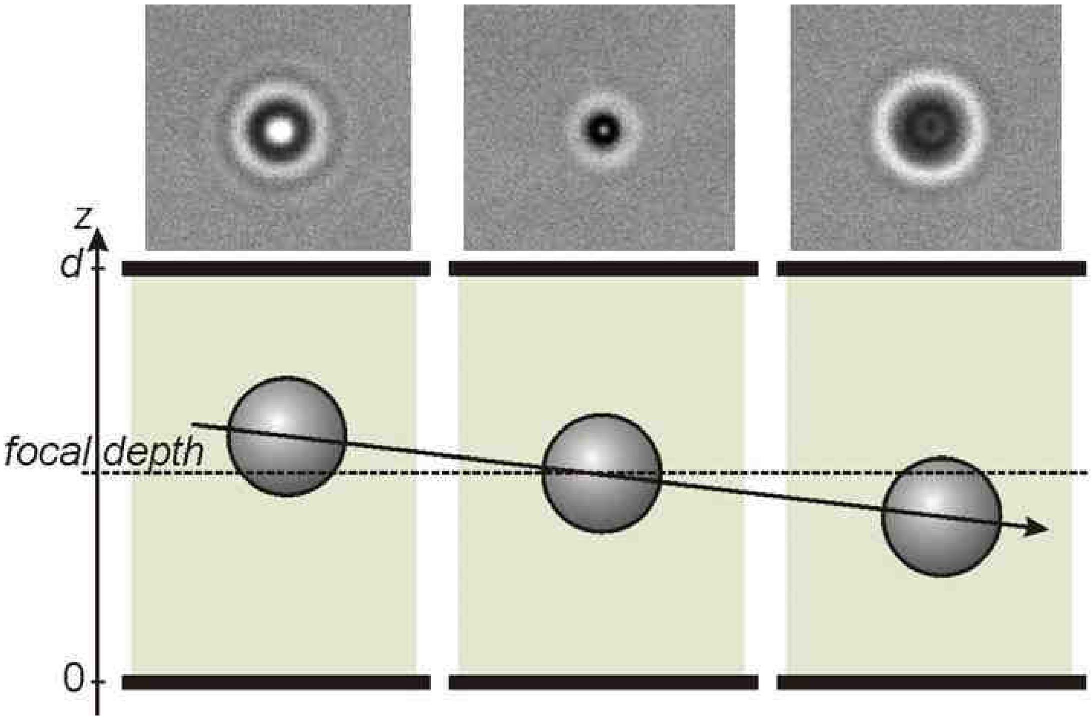
  The electrical charge of colloidal particles plays an important role in applications such as electrophoretic ink displays (Sony e-Reader, Kindle,â?¦) and liquid toner printing. Typically charging additives (surfactants) are added to charge up particles, but the precise mechanism of this charging is not understood. Video microscopy and optical trapping electrophoresis has been used in our group to measure charging processes on a particle-to-particle basis with accuracy high enough to see changes with plus or minus the elementary charge. This method offers a unique way to study the fundamental charging and de-charging processes which are relevant for these applications.

  Â  

  Doelstelling:
  Â
  The aim of this Master thesis is to study the electrical charge of particles used in e-ink displays with a precision higher than the elementary charge. To achieve this movies will be made of fluorescent particles using a microscope setup operated in LabView. By applying ac voltages the charge of the particles can be measured in real-time. Therefore the dynamic changes of the charge can be studied with high precision as a function of the particle size and concentration of additives such as surfactants. It is expected that the charge fluctuations will be more rapid when the concentration of surfactant is increased and when the particle size is larger.
  Â
- 11709 Rotational dynamics of ellipsoidal particles and liquid crystal droplets
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. Filip Strubbe
  Begeleider(s): ir. Caspar Schreuer
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

  Probleemstelling:
  Â
  Ellipsoidal particles are interesting for display applications because they can be aligned using electric fields. Similar to Brownian motion colloidal particles also carry out a Brownian rotation due to collisions with the molecules of the liquid. A combination of optical tweezing and advanced image analysis will be used to study the rotational dynamics of such microscopic colloidal particles in

absence and presence of electric fields. Liquid crystals droplets have many applications from displays to bio-detection. Here the orientation of liquid crystal droplets as well as changes in the refractive index due to electric fields will be investigated.
Â



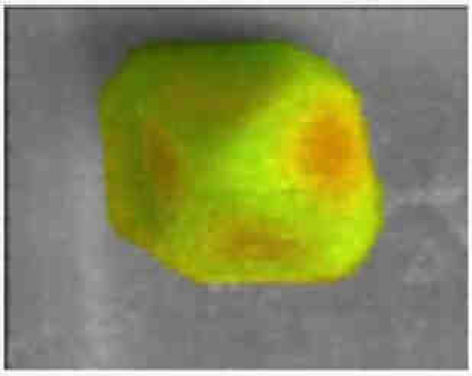
Doelstelling:
Â
The aim of this Master thesis is to investigate the rotational dynamics of non-spherical particles such as elliptical particles, spherical doublets and triplets as well as spherical liquid crystal droplets. This is achieved using single particle tracking microscopy and image analysis in LabView combined with optical trapping. With this analysis the 3D position and orientation of a single particle is measured as a function of time. Besides studying Brownian rotation, also electrical fields can be applied to study the forced rotation of particles. For spherical particles the same image analysis method can be used to measure the refractive index. By applying an electric field the orientation of the liquid crystal molecules can be changed and the resulting change in refractive index will be measured.
Â

Â
- 11714 Shape & size effects on the luminescence of single microparticles
  Promotoren: prof. dr. Philippe Smet en dr. Filip Strubbe
  Begeleider(s): Oksana Drobchak
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Â
Many materials are known that emit light under specific circumstances. The emission of light can be caused by incident light, electrical current, a chemical reaction,... These phenomena are respectively called photo-, electro- & chemiluminescence. Luminescence is ubiquitous and used for displays (e.g. OLEDs) and general lighting (e.g. LEDs), for emergency signage (glow-in-the-dark), for bioimaging, ...

Some examples of luminescence:
Efficient lighting with electroluminescence: http://www.youtube.com/watch?v=yRU8ui9c9lY&feature=channel_page
Fluorescent proteins used in biological/medical research: http://www.youtube.com/watch?v=n0UzdYRnMtY

High quality single crystalline calcium sulfide and strontium sulfide micro-particles containing rare earth ions (such as europium or cerium) with excellent luminescence properties have been produced in the LumiLab research group at the department of Solid State Science at UGent. These octahedral or cubiod particles have typical sizes ranging from hundreds of nm to no more than a few Âµm. Core-shell particles can easily be grown as well. Their size has a strong influence on the emission properties. For certain sizes optical waveguided modes exist (known as whispering gallery modes) and a narrowing of the emission spectrum can be observed in certain directions.

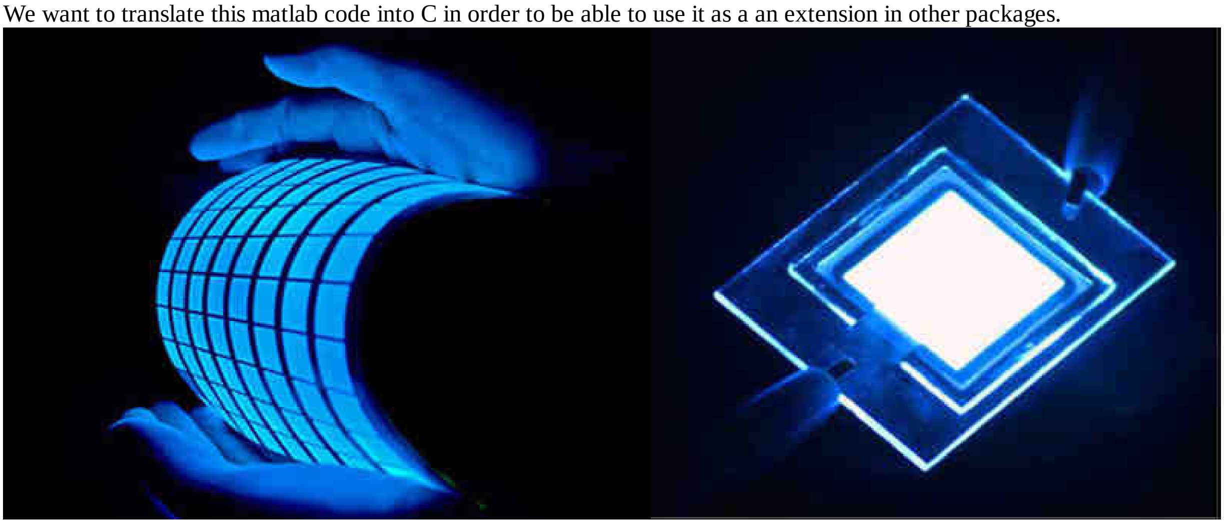


Doelstelling:
Â
The aim of this thesis is to characterize photoluminescent microparticles using fluorescence microscopy and confocal fluorescence microscopy. In standard fluorescence microscopy a homogeneous illumination excites the particle while with confocal microscopy the incoming excitation beam is focused onto a small spot. The latter makes it possible to study effects occurring inside a single micro-particle. The aim is to analyze movies and images of the emission of single photoluminescent crystal particles, and in such way to characterize the emission in different directions. By using optical tweezers it is possible to trap a single particle and to study it for many hours. The particles can also be placed in liquids with different refractive indices and there may be a metallic mirror in the vicinity. The luminescence emission properties obtained in the fluorescence microscope will be related to the (cathodoluminescence) emission spectroscopy which can be performed at the LumiLab research group.

Â

- 11857 Simulating tomorrows displays and lighting!
  Promotoren: prof. dr. ir. Kristiaan Neyts en dr. ir. Wouter Woestenborghs
  Begeleider(s): ir. Michiel Callens
  Richtingen: Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

  Probleemstelling:
  Organic Light Emitting Diodes (OLEDs) are an exciting and rapidly developing technology.
  They are revolutionizing the display market, showing unprecedentedÂ colourÂ rendering and contrast.
  Besides this these OLEDs can also be made flexible and even transparent! This is truly the technology of tomorrow!
  The most exciting thing, from a research perspective, is that this is a relativelyÂ new field and there is still plenty of room for improvement.Â
  We have matlab code that enables us to simulate these OLEDs with very good accuracy.Â
  Currently we are the onlyÂ people that have this kind of software that has theÂ capabilityÂ to simulate anisotropic layers as well as isotropic layers.
  We want to translate this matlab code into C in order to be able to use it as a an extension in other packages.

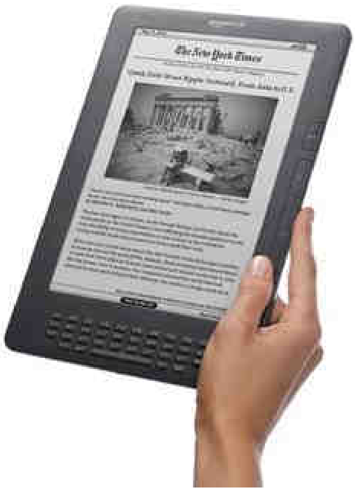
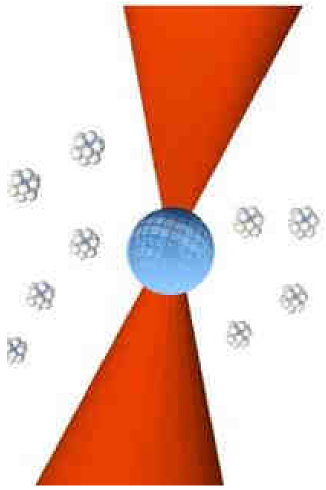
  
  Figure 1: Example of an OLED application. This is what you will be simulating!

  Doelstelling:
  In this master thesis you will be responsible for translating this matlab code into C code as well as testing the end result.
  Although prior knowledge of C is not essential it is advisable that you do have some experience in coding.Â
  Prior knowledgeÂ of OLEDs is also not a requirement although some basic knowledge of optics might come in handy.
  If you are looking for a master thesis that will have a lasting impact on further research, this is the thesis for you!
  You will have a lot of freedom in the work that you will do and you will find that the people you work with will be most interestedÂ in your work, since it affects them directly!
  If you have any questions on this subject, do not hesitate to contact Michiel (michiel.callens@elis.ugent.be) !
- 11700 Switching of charged particles in electrophoretic ink displays
  Promotoren: prof. dr. ir. Filip Beunis en dr. Filip Strubbe

Begeleider(s): Toon Brans
Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

Probleemstelling:
Â

Electrophoretic ink displays (Sony e-Reader, Kindle,â?¦) are based on the motion of charged pigment particles in an electric field. For the development of new applications based on this principle (full color displays, optical shutters, â?¦) there are two important questions that need to be answered: how do toner particles actually get charged and how do they move in response to an applied voltage.Â

Doelstelling:
Â

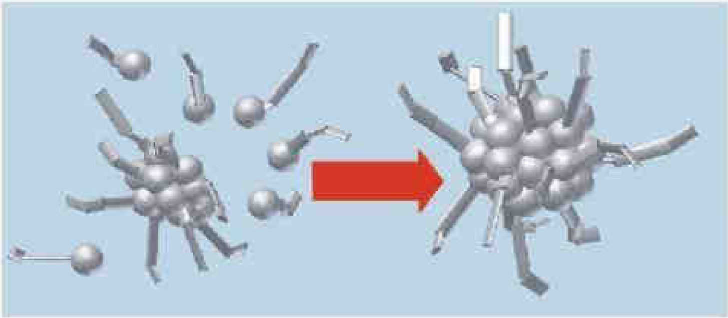
The aim of this Master thesis is firstly to investigate the motion of particles in one pixel of an electrophoretic display which is made in the cleanroom of Zwijnaarde. The trajectories of individual particles under influence of an electrical field are recorded using a microscope setup operated with LabView software. Even though some aspects of the switching behaviour are already well-understood the particle acceleration near the electrodes is still not fully understood. This effect, called electrophoretic retardation, will be studied using a combination of optical trapping of colloidal particles and video microscopy. In the second part of the thesis the mechanism of particle charging is investigated. Typically particles only get electrically charged by adding a dispersing agent to the particles but the precise mechanism is not known. Here, again optical trapping electrophoresis is used to measure the particle charge under different conditions of the dispersing agent and the electric field.

Â

- 11725 Temperature dependency of the critical micelle concentration
  Promotoren: prof. dr. ir. Filip Beunis en dr. Filip Strubbe
  Begeleider(s): Oksana Drobchak
  Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in Engineering Physics

  Probleemstelling:

  The research of the properties and behavior of mixtures of a non-polar liquid with surfactant plays an important role for application such as electrophoretic ink displays (e-paper), liquid toner printing and the petroleum industry. Surfactant molecules spontaneously form micelles in a solvent above a certain surfactant concentration, which is called the critical micelle concentration (CMC). The parameters of micellization (for example the CMC, aggregation number, etc) can be affected by various factors such as temperature, type of solvent, pressure, pH etc. In this study the dependency of the CMC on temperature is investigated. To detect the concentration of micelles and the CMC, the scattering of laser light on solutions with surfactant is detected and analyzed. Below the CMC the scattering intensity is very low. Above the CMC, the micelles which typically are a few nanometer in size scatter much more light than free surfactant molecules.



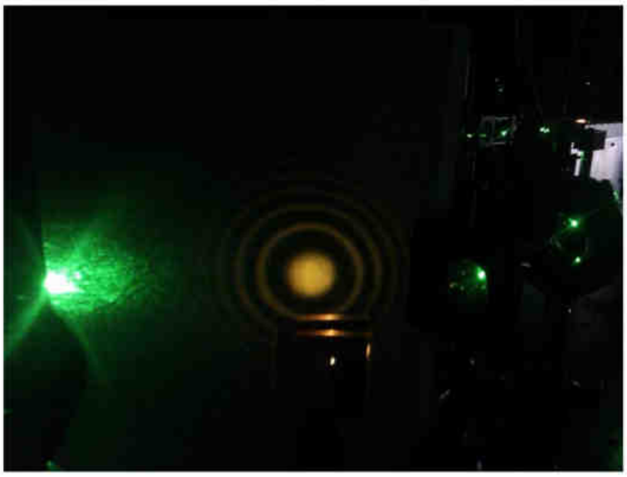
Doelstelling:
Â
The aim of this Master thesis is to investigate the critical micelle concentration of solutions relevant for e-ink displays as a function of temperature. To achieve this, a laser scattering setup is used to measure how the scattered light intensity depends on the surfactant concentration for different temperatures. This information is then used:
Â

- To investigate the dependence of CMC on temperature.
- To investigate the dependence of solubility on temperature.
- To determine the or cloud point.
- To determine the type of surfactant (ionic, nonionic).

- 11366 Understanding liquid crystal laser emission
Promotoren: prof. dr. ir. Jeroen Beeckman en prof. dr. Geert Morthier
Begeleider(s): ir. Inge Nys
Richtingen: Master of Science in Electrical Engineering, Master of Science in de ingenieurswetenschappen: elektrotechniek, Master of Science in de ingenieurswetenschappen: fotonica, Master of Science in Photonics Engineering, European Master of Science in Photonics, Master of Science in Engineering Physics

Probleemstelling:
Liquid crystal lasers have great potential as small-size, low-cost, widely-tunable lasers. The general characteristics (laser threshold, slope efficiency, etc.) of liquid crystal lasers are well studied but not much is known about the time and angular dependency of the emission.Â Liquid crystal lasers contain dye molecules that are excited by irradiationn with a short optical pulse. The emission depends on the dye molecule and on the cavity in which the liquid crystal is embedded. The aim is to obtain information about the lasing mechanism by studyingÂ the time and angular dependency of the emission.

Recently the LCP group has demonstrated that nematic liquid crystal cells with small mirror reflectivities (only a few percent) can give rise to Fabry-Perot lasing.Â The gain is provided by dye molecules, while the cavity mirrors provide optical feedback. A second way to obtain optical feedback in liquid crystals, is by multiple scattering. In this case, random lasing can arise, which leads to a strong pulse-to-pulse variation. In this project we want to study the timeÂ and angular dependencyÂ of the laser pulses to discriminate between random lasing and Fabry-Perot type of lasing.



Liquid crystal laser emission in concentric circles

Doelstelling:
The aim of this thesis is to obtain new knowledge about lasing mechanisms and time dynamics of lasing processes in liquid crystals. The goal is to significantly enhance the general understanding of both random and Fabry-Perot type of lasing.

The student will work with an optical setup and will use his/her creativity to find an efficient way for measuring some lasing parameters.