

The **Institute of Advanced Optical Technologies – Thermophysical Properties (AOT-TP)** offers a

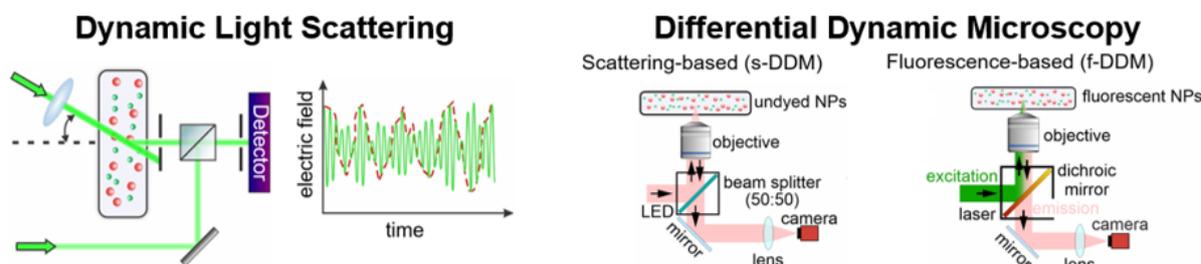
## Master's Thesis

with the tentative title

### Characterisation of Diffusion of Nanoparticles

This master's thesis is part of the Collaborative Research Centre 1411 (CRC 1411) which focuses on the targeted design of particulate products and the development of corresponding processes. For this, a fundamental understanding of particle diffusion characterized by the particle diffusivity  $D$  is essential. In this context, a comprehensive understanding of the influence of the characteristics of the particles, i.e., their morphology (size and shape), concentration, and surface properties, as well as of the dispersing fluid on  $D$  has to be developed. Considering realistic processes and applications involving particulate products, such as particle separation by chromatography using complex porous columns, not only particle diffusion in free media but also under confinement has to be understood.

For the characterization of particle diffusion, two-photon correlation spectroscopy (PCS) techniques, i.e., **dynamic light scattering (DLS)** and **differential dynamic microscopy (DDM)**, are being developed and applied at AOT-TP for the reliable and accurate determination of  $D$  in particle dispersions.



In this master's thesis, one of several topics related to the investigation of various aspects influencing particle diffusion may be addressed. One aspect that is in the focus of ongoing investigations is the diffusion of anisotropic nanoparticles (NPs). Here, DLS gives simultaneous access to translational ( $D_T$ ) and rotational ( $D_R$ ) diffusivities by applying a polarized and depolarized detection scheme and can therefore be applied to characterize the anisotropy of NPs. In this context, the capabilities of DLS for the reliable determination of both  $D_T$  and  $D_R$  should be evaluated studying unimodal dispersions of NPs with systematically varied size, shape, and aspect ratio, such as nanorods (NRs), nanowires, and nanoplates. These studies should be performed studying particle concentrations ranging from infinite dilution up to the stability limit and, furthermore the dynamic viscosity  $\eta$  of the base fluid for dispersions of selected NRs with different aspect ratios to investigate the behavior of  $D_R$  in comparison with the predictions given by hydrodynamic theory.

Another aspect addressed in current research activities is the characterization of particle diffusion under confinement, where the influences of geometric confinement as well as particle-wall, particle-fluid, and fluid-wall interactions on  $D$  are investigated. Here,  $D$  in unimodal dispersions of isotropic particles should be characterized under the confinement of simple geometries, such as a wedge-shaped sample cell, as well as of complex porous structures in the form of porous monoliths, inverse opals, and opals. These studies further include the investigation of the influence of different surface characteristics of the particles and the confining walls which are, e.g., defined by their charge or surface functionalization on particle diffusion under confinement.

This master's thesis offers the opportunity to contribute to the research field of optical metrology, colloid science, and thermophysical property analysis within a diverse, multidisciplinary, and international working environment with excellent potential for scientific and personal development.

**Start of the thesis:** as soon as possible

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