Available MSc projects

**The road to a quantum dot-based plasma diagnostics technique**
Semiconductor quantum dots (QDs) continue to attract enormous interest for their applications in optoelectronics and light emitting devices. In this project we mainly focus on the understanding plasma charging by using photoluminescencce (PL) properties of QDs. The proposed experiments merge three fascinating processes: controlled injection of colloidal CdSe/ZnS QDs inside the low pressure RF plasma, the ability of plasma discharge to charge and confine nanoparticles, and monitoring the surface charge-induced shift in PL spectrum of QDs in the plasma. This time-resolved PL shift of QDs will be utilized to probe the different processes behind plasma-particles interaction for the first time ever!

Contact Zahra Marvi: z.marvi@tue.nl

**Exploring the (de)charging of small particles in plasma afterglow**
When small dust particles are immersed into a plasma, these particles are electrically charged. Utilizing this complex but interesting phenomenon of plasma-charging, the path of particles can eventually be controlled using electric and/or magnetic fields, either externally applied or induced by the plasma itself. In this project the (de)charging principles in the afterglow of the plasma are to be studied. The results will be compared to the developed (de)charging model. Measuring the (de)charging of particles in the plasma afterglow is never done before. This is interesting new research in collaboration with VDL-ETG!

Contact Boy van Minderhout: b.v.minderhout@tue.nl

**Modelling of atmospheric pressure DBD plasma in a roll-to-roll configuration (in cooperation with DIFFER and FujiFilm)**
Atmospheric-pressure plasma enhanced chemical vapour deposition (AP-PECVD) is a novel technology to manufacture functional thin films. The aim of the project is to model the spatial-temporal discharge evolution in the DBD with different electrode geometries. The modelling results will be combined and evaluated with respect to the experimental work executed in DIFFER and Fujifilm. The knowledge obtained by the simulations will help to provide a deeper insight into the plasma generation mechanism and the thin film growth.

Contact Diana Mihailova: d.mihailova@tue.nl

**Forbidden dust growth**
Growing dust in a plasma requires the plasma to fulfill certain criteria. The goal of this project is force the plasma to grow dust in very unfavorable conditions (for the plasma, not for the student).

Contact Bart Platier: b.platier@tue.nl

**Pockels-based electric field measurements in atmospheric-pressure plasmas**
DBDs are plasma sources that operate at atmospheric pressure and are researched for use in medicine. There is a lack of fundamental knowledge concerning the properties of these sources, for example the electric field is a very difficult property to measure. The focus of the project is the measurements of the electric field that the plasma delivers to the target. A setup needs to be built and calibrated for use with various types of solid and liquid targets.

Contact Ana Sobota: a.sobota@tue.nl

**Development of Boltzmann solver**
In plasma physics the collisions of electrons with heavy particles play an important role in the evolution of the plasma. For plasmas with a high degree of ionization the Electron Energy Distribution Function (EEDF) is in approximation a Maxwellian function. For low ionization degrees, however, this approximation is not valid anymore, and the EEDF needs to be calculated. In this project a Master student will develop and validate an own Boltzmann solver.

Contact Peter Koelman: p.m.j.koelman@tue.nl

**Dust growth in an atmospheric pressure plasma**
Nanometer to micrometer dust particles can be used in many applications. For industrial applications it is highly advantageous to create these particles at atmospheric pressure instead of in vacuum. For this reason the possibility of growing dust, with good control over the properties, needs to be explored.

Contact Bart Platier: b.platier@tue.nl

**The next step in ultrafine particle sensing**
The increased usage and awareness of ultrafine particles drive the need for accurate and low-cost measurement solutions. Recently this trend has accelerated by the introduction of first regulatory frameworks controlling and limiting emissions of ultrafine particles in e.g. 3D printing. In our group, we study one of the most promising concepts of such particle sensors.
More specifically, together with our industrial partner we are working on improving the concept of diffusion-charge based sensing, where particles are charged through plasma generated ions, and in a secondary stage measured with a fA accurate electrometer. Various directions on improving the current design are available.

In this project you will focus on those aspects of the sensor that can be modified through software parameters or control algorithms (the re-design of hardware is scheduled for a next phase), giving you the opportunity to move quickly from physical modelling and laboratory experiments towards actual implementation in the sensor.

Contact Tim Staps: t.j.a.staps@tue.nl

The elementary process of electron detachment from dust particles

Electron detachment induced by photon irradiation is an extremely powerful technique to study the properties of dust particles. Surface-bounded electrons can be detached from such particles using ultraviolet lasers to induce an effective production of free electrons. However, the electron density will quickly rise and consequently must be measured on the nanosecond timescale to actually follow the behavior of the detached electrons. In this project, you will investigate this (de)charging process of nanoparticles immersed in a plasma by combining two state-of-the-art techniques: UV-photodetachment and microwave cavity resonance spectroscopy. As a consequence, the project contains a significant amount of experimental work.

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