Master thesis: *„Synthesis and characterization of quantum-dot-covered microparticles for optical measurements of microparticle charges in low-temperature plasmas“*

Charging of micrometer-sized particles due to triboelectricity or collection of electrons and ions from the surrounding ionized medium is an important process in many natural and application-oriented processes.

Charge measurements of micrometer-sized particles in plasmas are traditionally performed using dynamical methods which are limited in spatiotemporal resolution and require often not easily verifiable assumptions. Optical charge measurements could potentially solve both issues and provide more reliable, spatiotemporally resolved values of microparticle charges. Development of optical methods could make important contributions to, e.g., investigations of the behavior of dust on the Lunar surface or to the improvement of modern EUV lithography.

One of the possible approaches in achieving this is to use the fluorescence of quantum dots attached to the surface of microparticles. Quantum dots are subject to the so-called quantum-confined Stark effect, i.e., in an external electric field, the spectrum of their fluorescence experiences a red shift which is proportional to the square of the electric field.

The goal of this work is to develop a chemical technique to synthesize the quantum-dot-covered microparticles using off-the-shelf microparticles and quantum dots. The quantum-dot-covered microparticles will need to be characterized using fluorescence spectroscopy and transmission electron microscopy. Environmental stability of the quantum-dot-covered microparticles in the powder form will need to be investigated. Finally, the quantum-dot-covered microparticles will need to be tested in a plasma.

This work is a collaboration between DLR Institute for Materials Physics in Space in Cologne, Germany and Eindhoven university in Netherlands. Synthesis and characterization of the microparticles will be performed in Cologne and plasma tests in Eindhoven.

The prospective candidate must be a student in chemistry and must have experience and knowledge of laboratory wet chemistry. In addition, very good knowledge of written and spoken English, initiative and independent approach to work are required.

Earliest possible start: 01.02.2023

Duration of the work: 1 year

For further information, contact Dr. Mikhail Pustylnik at DLR Institute for Materials Physics in Space: mikhail.pustylnik@dlr.de