Decoupling of dust cloud and embedding plasma for high electron depletion in nanodusty plasmas

A. Petersen[1], O. Asnaz[1], B. Tadsen[1], F. Greiner[1]

[1] *Institute of Experimental and Applied Physics, Kiel University*

Understanding how dust particles can grow in a reactive plasma discharge and change its behavior, is an interesting topic, since nanoparticles (nps) have become key technological products, e.g. as coatings with tunable optical gap in third generation solar cells, as nanocrystals for photonic applications, and as pharmaceutical nanocarriers.

We have been able, to characterize an argon discharge with embedded amorphous hydrocarbon nps of different size and density, using self excited dust density waves (DDW) as a diagnostic tool [1].

It is known from observations of spokes in Saturns rings [2] that electrons get captured on dust particles and can leave the plasma electron depleted. With comparably high dust density (high Havnes parameter P) such electron depletion in turn governs the charge of dust grains q_d, while the nps size has only a weak influence (fig. 1). The ion density and electric potential profile (fig. 2) are almost independent of both, dust size as well as dust density. This suggests, that the ion generation and the dust cloud coexist and the coupling of both is weak [3].

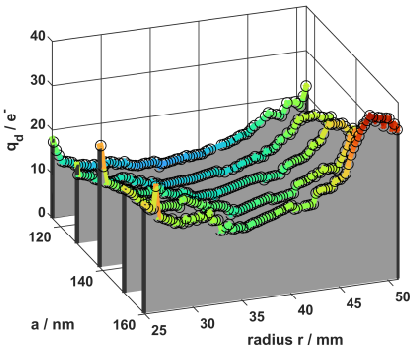

Figure 1: Grain charge q_d for sizes a of 117 nm to 158 nm is near constant compared to OML.

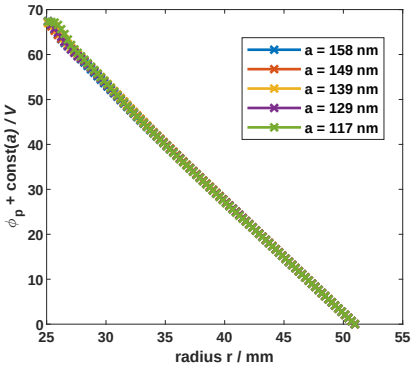

Figure 2: Plasma potential Φ_P is close to independent of the grain size.

References

[1] B. Tadsen et al, Physics of Plasmas 22, 113701, doi: 10.1063/1.4934927.

[2] O. Havnes et al, J. Geophys. Res., 89 (A12), 10999 – 11003, doi: 10.1029/JA089iA12p10999.

[3] A. Petersen et al, PREPRINT, doi: 10.21203/rs.3.rs-1192899/v1.

Acknowledgements

We gratefully acknowledge funding of the project GR1608/8-1 “Dusty plasmas with high electron depletion: Investigation of fundamental mechanisms and properties through particle and plasma diagnostic” by Deutsche Forschungsgemeinschaft (DFG).