Size evolution and plasma-particle interaction of single MF particles in the plasma sheath

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Complex (dusty) plasmas consist of micrometer sized particles in addition to the typical plasma species of ions, electrons and neutrals. These particles are charged in the plasma and can form strongly coupled systems, allowing to study e.g. phase transitions or thermodynamical properties of such systems. However, it has been observed, that the particle size decreases for many materials during plasma exposure and that the particle surface is modified, influencing charge and interaction forces of the particles. This process is commonly referred to as "etching", although in the context of dusty plasmas the detailed mechanism and surface reactions behind the decreasing size is not known yet and proposed explanations range from physical sputtering, over melting of the particle material to ion enhanced chemical reactions. We use an advanced light scattering diagnostic based on Lorentz-Mie theory to determine size and size evolution of single melamine formaldehyde (MF) particles in situ and with high temporal resolution. By adding small amounts of oxygen to the discharge, the etch process and plasma particle interaction become accessible [1]. We will present precise measurements of the size evolution of single particles complemented with a reactive site model [2] that suggests an increase in surface reactions due to a roughening of the particle surface and matches well with the observed accelerated etch process.

References

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