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Managing Particle Formation in Plasmas

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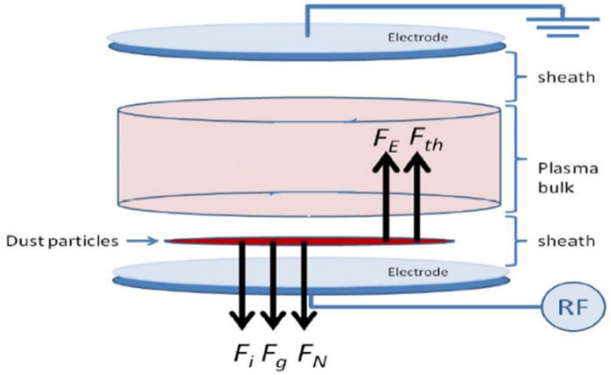
- Gas phase nucleation & plasma etching
  - Contamination particles “dusty”
- Impacts overall yield and equipment efficiency
  - Size (nm) defects in downstream processes
- Process & species in the process, gas, or substrate
  - Electrostatics, transport, and clustering
  - Flow rate, temperature, and pressure control
  - Sheath, plasma boundary (“-” charge particle)



Beckers, J. (2011). Dust Particle(s) (as) Diagnostics in Plasmas. Phd thesis. Eindhoven University of Technologie. 1-36.

- Formation of -’ve ion cluster (example, Silane)
  - $e + SiH_4 \rightarrow SiH_3^- + H$
  - $Si_jH_x^- + SiH_y \rightarrow Si_{j+1}Hz^- + (H\ products)$
- Addition of -’ve dust particles complicate the equilibrium plasma structure in a discharge:
  - Particles induce e^- loss ($n_e << n_{dust}, n_i$) and lead to electronegative plasma equilibrium w/ higher T_e

- Introduce electrostatic particle traps
  - Create grooves (µm to mm) into electrode
  - Adjust gas flow rate (≈200 sccm)
- Apply bias voltage (≥425 V) to the substrate
- Mount substrate vertically
- Pulsed Power Modulation
- Use laser beam
- Use high gas flow