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EUV- Induced plasmas in EUV lithography tools, Job Beckers

Job Beckers

Eindhoven University of Technology, The Netherlands

Biography

Job Beckers is an Assistant Professor within the Elementary Processes in Gas Discharges group at Eindhoven University of Technology (TU/e). His research focuses on discovering how nanometer- to micrometer-scale particles interact with plasmas on the most fundamental level.

Abstarct

Today's newest photolithography tools operate using photons in the Extreme Ultra Violet (EUV) wavelength range and at low hydrogen gas pressures, typically 1-10 Pa. Everywhere in the machine where these highly energetic photons travel, a peculiar transient background plasma is induced. The formation of such plasma is the results of the partial photoionization of the background gas by the photons used. Additionally, the created free electrons have sufficient energy to continue the ionization of the background gas even further by means of electron impact ionization. The inevitable presence of EUV-induced plasmas in lithography tools may have significant impact on the EUV optics used in these systems in terms of contamination, cleaning and life-time issues. In this contribution we focus on our research efforts probing the dynamics of the two most dominant species in plasmas, i.e. electrons and positive ions. The electrons have extensively been probed using microwave radiation in the so-called Microwave Cavity Resonant Spectroscopy (MCRS) diagnostic. Our latest improvements with respect to MCRS enabled to monitor free electron dynamics in the plasma temporally resolved (~100 ns resolution) and with a high resolution (low detection limit of 1010 m-3). Utilizing multiple resonant modes, this diagnostic can be used to spatially resolve the electron density profile and to act as a beam monitor for pointing stability and beam power. The fluxes and energy distributions of ions towards plasma-facing surfaces have been characterized temporally resolved using a Retarding Field Energy Analyzer (RFEA) and an Electrostatic Quadrupole Plasma analyzer (EQP). This contribution shows the current state-of-the-art knowledge level regarding EUV-induced plasmas as well as some latest results and our research plans for the future.

Publications

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