Radiation driven plasma

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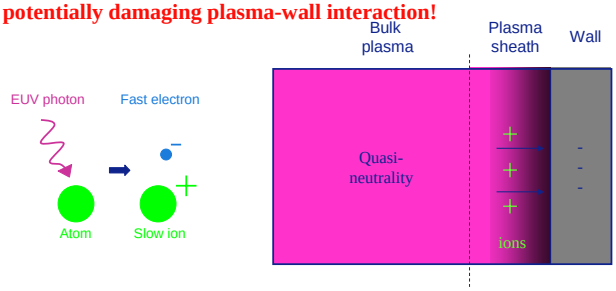
1. Motivation:

- Optical path enclosed in vacuum system to minimize EUV-absorption;
- Argon background pressure of p = 10^{-3} - 10^{-2} mbar due to Dynamic Gas Lock;
- Consequence:

The background gas is (partially) photo-ionized by the EUV radiation creating a plasma and thus inducing potentially damaging plasma-wall interaction!

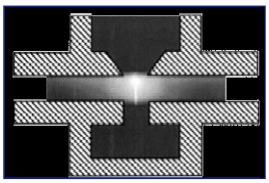


Positively charged ions can be accelerated towards the walls.

Project goals:
- To study the effect of the radiation driven plasma on walls;
- To find means to influence the plasma parameters.

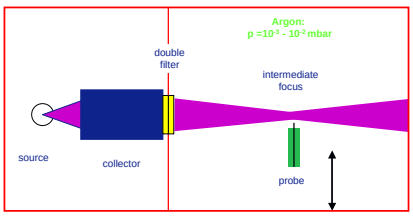
2. Experimental setup:

- EUV Source: Hollow Cathode Discharge, Pinch plasma, 100 ns EUV pulse;
- Debris mitigation: Foil trap and filter;
- 1-shell collector mirror: Grazing incidence.



Hollow Cathode discharge

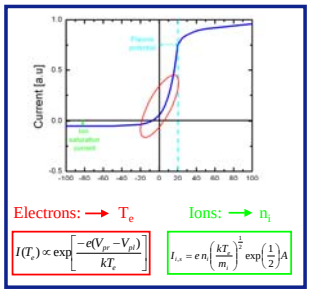
Emission of the EUV driven nitrogen plasma.



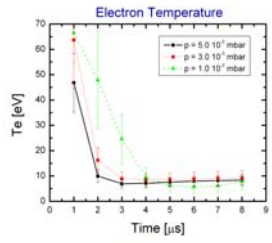
Schematic experimental setup

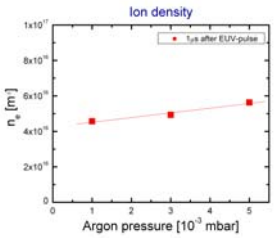
3. Time-resolved probe measurements:

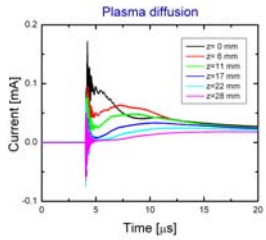
- Plasma parameter characterization with single Langmuir probe.
  - ion density/ionization degree;
  - electron temperature/mean electron energy;
  - time-scales.



4. Preliminary results:







5. Conclusion:

- Electron temperature from 1 μs after EUV- pulse;
- Agreement T_e with Monte-Carlo model V. Ivanov, ISAN, Troitsk, Russia;
- Ion density:
  1) Photo-effect obscures measurement;
  2) Signal-to-noise ratio too low;
- Plasma diffusion, Ambipolar, recombination on walls.

6. Future plans:

- Measurement of plasma-wall interaction with a Quartz Crystal Microbalance (QCM);
- Further characterization of the plasma with Optical Emission Spectroscopy and Thompson Scattering;
- Modeling of the plasma-wall interaction with Monte-Carlo simulations;
- Other...