Ion Fluxes Impacting Surfaces Exposed to EUV-Induced Plasma

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~few Pa gas
photon + H₂ → H₂⁺ + e⁻
EUV + gas → plasma
Characterize the ion fluxes towards surfaces exposed to EUV-induced plasma

Hollow cathode
Xe pinch discharge
500 Hz
150 μJ/pulse

Power sensor
Focus

Collector mirrors
Optical filter

EUV source

Ion mass spectrometer
or
RFEA

H₂
Pump

Cylinder
Evolution of the ion-flux density

The temporal evolution of the ion-flux density can be described using classic plasma physical concepts.
Ion-flux composition and energy distribution

$\text{H}_3^+$ is most abundant

Ion energies are low (<10 eV)

Energy distribution of $\text{H}^+$ has a high-energy tail

T.H.M. van de Ven, P. Reefman, C.A. de Meijere, R.M. van der Horst, M. van Kampen, V.Y. Banine and J. Beckers, Ion energy distributions in highly transient EUV induced plasma in hydrogen, Journal of Applied Physics, 123(7), 2018
Plasma remains ‘hot’ for longer than expected

Possible explanation:
Superelastic collisions electrons and vibrationally excited H$_2$
Ion Fluence can be modeled

H⁺ energetic tail

Plasma remains ‘hot’
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Ion fluence can be modeled

$H^+$ energetic tail

Plasma remains ‘hot’