A novel low-temperature hydrogen plasma source for EUV lithography applications

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Inside EUV lithography machines a hydrogen plasma is generated due to ionization of hydrogen molecules with EUV photons. Scanner components interact with this plasma, which is a topic of many life-time investigations. These studies can be rather costly when using experimental setups equipped with EUV sources. However, there are other ways to mimic certain aspects of the EUV-generated plasma using non-EUV plasma sources, but they all come with their own drawbacks. TNO presents a new novel experimental setup, where a low temperature hydrogen plasma is generated by electron impact ionization process (see Fig.1). The electron beam is generated using a high pressure/current e-beam (TES-63-ES, Polygon Physics). Using a retarding field energy analyzer the ion flux and ion energy distribution function were measured, which shown to be comparable to the scanner plasma. Moreover, experiments shows that carbon cleaning rates are similar to hydrogen radical generators but without the drawback of the high heat load. Finally, compared to setups equipped with microwave or RF sources, our setup shows a minimal molecular contaminations, which makes it suitable for life-time testing of various scanner components.

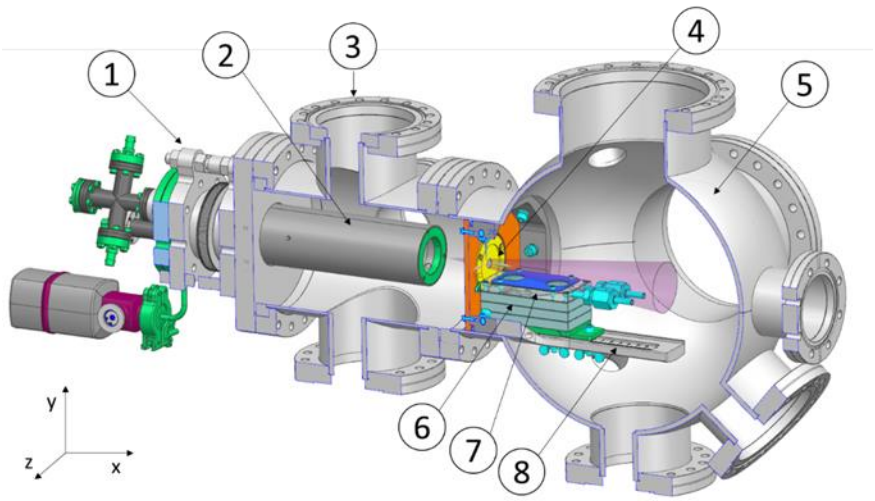

FIG. 1. Schematic cross-sectional view of the EBR setup containing a port aligner (1) used for mounting an e-gun (2) onto a smaller vacuum vessel (3), which is connected via a 10 mm orifice (4) with a main, exposure chamber (5). A sample stage (6) consist of 3 x 1 cm spacers and a top, water-cooled plate (7), which has openings for two 1” samples. The stage is positioned on a rail (8), which allows for its movement along the x-axis.