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# Carbon layers cleaning from inside of narrow gaps by a RF glow discharge

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This paper focuses on the utilization of a radiofrequency discharge at intermediate pressures for plasma removal of carbon residuals or layers from narrow gaps and channels. The specific applications are the cleaning of the injection moulds in plastics industry, etching of surfaces with complex form (~e.g., for MEMS) or cleaning of the co-deposited layers enriched in tritium from the castellated tiles of the fusion machines. The experiments were realized in a dedicated set-up consisting of a discharge chamber provided with two parallel electrodes. The active RF powered electrode is water cooled and movable. It is shaped like a disk and back covered with Teflon, which prevents the discharge burning behind it. The castellated piece to be cleaned is flat, has large area and is used as counter electrode. It is grounded, and its surface is coated with the material to be cleaned. The setup operation is assisted by a motion control system, RF power supplying system, pressure control system, and water cooling system. The criteria for adequate operation were the formation of a diffuse plasma volume in-between the electrodes and the penetration of the discharge inside the gaps.
The material used for removal experiments was amorphous hydrogenated carbon deposited by Plasma Assisted Chemical Vapor Deposition. The castellated substrate was assembled from separate polished aluminum cubic pieces, uniformly coated on all sides, and was submitted to cleaning. The generation of discharge inside the gaps was studied for argon/air mixtures, at 5-100 mbar for rectangular gaps with the width in the range 0.6 2 mm. After cleaning procedures the castellated substrate was dismantled and the thickness profile inside the gaps, at different treatment times, was measured by profilometry and ellipsometry. Removal rates of about 0.3 microns/min were obtained inside the gaps, almost ten times large than on the flat upper surface. The removal rate is higher at the gaps upper margins. The main limitation of the technique appears to be plasma segmentation inside the gaps.

**Keywords**
plasma cleaning
discharges in gaps
radiofrequency discharges