Abstract Submitted
for the GEC15 Meeting of
The American Physical Society

Measuring IVDF through high-aspect holes in pulsed ICP plasma[1] GILLES CUNGE, MAXIME DARNON, JEROME DUBOIS, PHILIPPE BEZARD, ODILE MOUREY, CAMILLE PETIT-ETIENNE, LAURENT VALLIER, EMILIE DESPIAU-PUJO, OLIVIER JOUBERT, NADER SADEGHI, LTM-CNRS — Plasma etching of high aspect-ratio (AR) structures is challenging. Several issues originate from the ion angular distribution: the feature sidewalls are bombarded by energetic ions and the ion flux at the bottom of the features is reduced. In ICP reactors at low pressure, this angular dispersion is due to two effects: the finite transverse velocity component of the ions when they enter the sheath region (i.e. the ion temperature Ti in plasma bulk) and charging effect of the feature sidewalls. To analyze those effects, we have measured the IVDF at the wafer surface in an industrial ICP reactor (AMAT) by using Semion multigrid ion energy analyzers. The plasma is operated in different chemistries (Ar, He, H_2 and CF_4) both in CW and pulsed mode. To analyze ion transport through high AR holes, we place 0.4 mm thick capillary plates with holes of AR 16, 8 and 4 in front of the RFA analyzer, which then probe IVDF at the exit of these holes. The results show that the ion flux drops dramatically when the AR is increased. By comparing the measured IVDF with an analytical model which calculates the transmission of a hole as a function of its AR and of T_i we concluded that Ti is about 3000 K. Charging effects are also observed and are shown to reduce significantly the ion energy at the feature bottom but with a "minor" effect on the ion flux and shape of the IVDF. We will discuss electropositive versus electronegative gases, pulsing and the role of ion mass on charging.

[1]This project is funded by the French Agence Nationale de la Recherche in the frame of the project cleanGRAPH (ANR-13-BS09-0019)

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Date submitted: 15 Jun 2015 Electronic form version 1.4