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Scaling laws governing the NF3 cleaning plasma in a large area reactor

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An important part of the thin film Silicon PECVD technology for photovoltaic industry is the Fluorine based plasma cleaning of the reactor. Precursors as C_xF_y, SF_6, NF_3 or even F_2 can be used. The present paper investigates scaling laws governing the processes in NF_3 plasma in a large area reactor.
The production of homogeneous deposition and cleaning plasma in a large area (1.4 x 1.1 m^2) reactor is a quite challenging task, because these plasmas are operated in quite different pressure and power regimes. The homogeneity of the cleaning process has been studied in current production type wide inter-electrode gap reactors and in the newly developed generation of small gap reactors.
The composition of the gas leaving the reactor was investigated via mass spectrometry. We show that the pressure established in reactor at fixed butterfly position is a rough measure of the dissociation degree. The electrical parameters of the discharge as DC Bias or Load and Tune values of the matchbox gave global information about the plasma impedance. The Fluorine atom density was estimated by mean of actinometry.
Very simple scaling laws govern the process in spite of the complex involved phenomena. The creation of F_2 and N_2 in clean reactor depend of the Yasuda-like parameter: delivered power divided by input flow. A similar scaling but at different value of the said parameter was found for the cleaning time in case of NF_3 plasma in deposited reactor. The electron density and the density of atomic Fluorine follow a different scenario: they increase almost linear with the applied power, as predicted by the global model of Lieberman.

Keywords
NF3
scaling law
dissociation degree
Yasuda-like parameter