Plasma potential structure under the shower-head RF electrode

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Numerical calculations indicate that in the vicinity of the RF electrode, at the position corresponding to the gas inlets, the plasma potential is locally enhanced. Consequently, the densities of film precursors are enhanced. The effect can be relevant or negligible for film uniformity depending on the plasma process to be sustained and on the electrodes separation.

The contribution focus particular aspects of an industrial large area capacitive coupled plasma source [1] used for the PECVD of thin film silicon photovoltaic modules. The source is extensively employed to cover 1.4 m^2 glass substrates with a combination of amorphous and microcrystalline silicon layers ensuring currently about 143 Wp stabilized power [2]. Microcrystalline layers are important for the overall power balance and represent and sensitive step of the process chain. In general, reactor design and development request considerable care and precision to allow the deposition of microcrystalline films with uniform properties over the module area.

Plasma parameters corresponding to deposition of microcrystalline films have been investigated by means of 2d fluid numerical calculations. The results reveal that *i)* the discharge ignites also behind the corrective layer [1] for standard reactor configurations, and *ii)* in front of the gas inlets an enhancement of plasma potential is observed. The result is confirmed by experiments carried out on test bench- and regular-size reactors. We discuss in this contribution the particular conditions (pressure, gap, frequency) that enhance the effect and may cause local non-uniformities of deposited films.

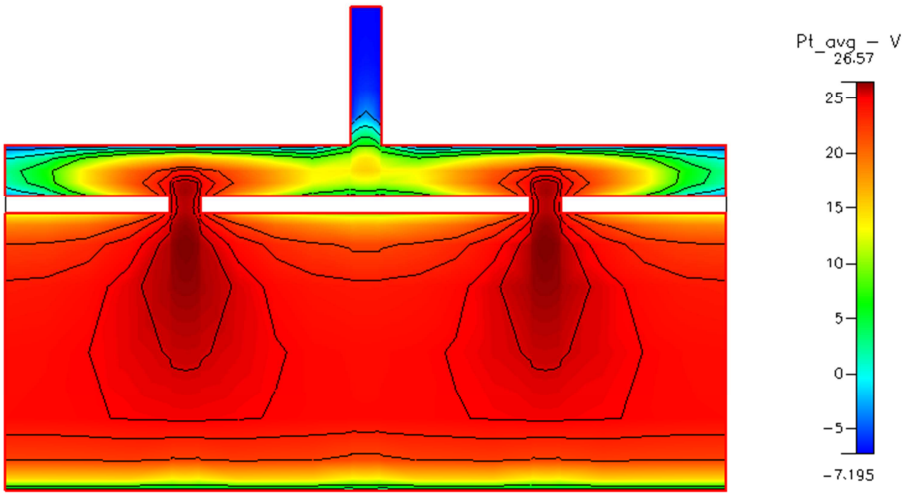

Fig. 1: Time average distribution of the plasma potential in the simulation domain. The simulation corresponds to a discharge sustained in SiH4-H2 mixture at 40.68 MHz.

References

[1] A. Salabaş et al., WO 2011/138239 A1, 29 April 2011.
[2] www.oerlikon.com