

Comparing surfatron plasmas in Ar with and without SiCl₄

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Comparing surfatron plasmas in Ar with and without SiCl₄

J.F.J. Janssen¹, J.L.G. Suijker², J. Van Dijk¹

¹ Department of Applied Physics, Eindhoven University of Technology, PO Box 513, NL-5600 MB, Eindhoven, The Netherlands

² Philips Lighting B.V., BG Light Sources & Electronics, P.O. Box 80020, NL-5600 JM, Eindhoven, The Netherlands

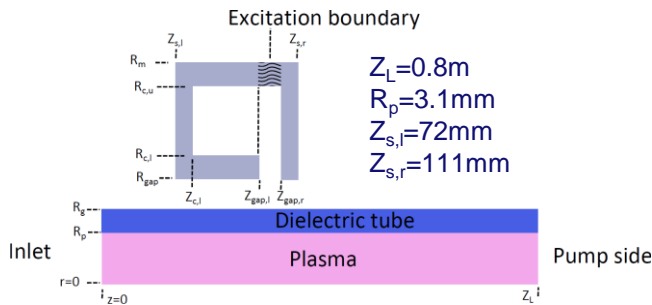
Contact: j.f.j.janssen@tue.nl



Introduction

Glass fibers can be produced via plasma enhanced chemical vapor deposition (PECVD). In such a process O₂ and SiCl₄ are fed to a microwave reactor. Due to the absorption of the microwaves various species are formed in the plasma. In simplified mixtures of Ar and Ar+SiCl₄ the effect of SiCl₄ on the discharge is investigated.

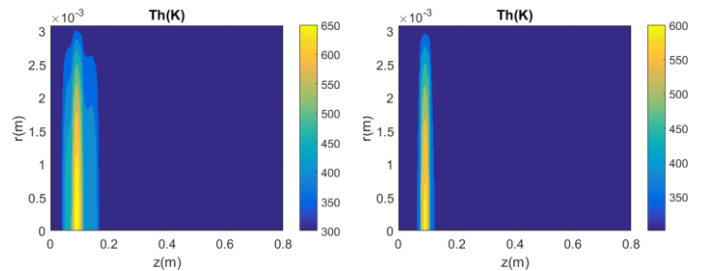
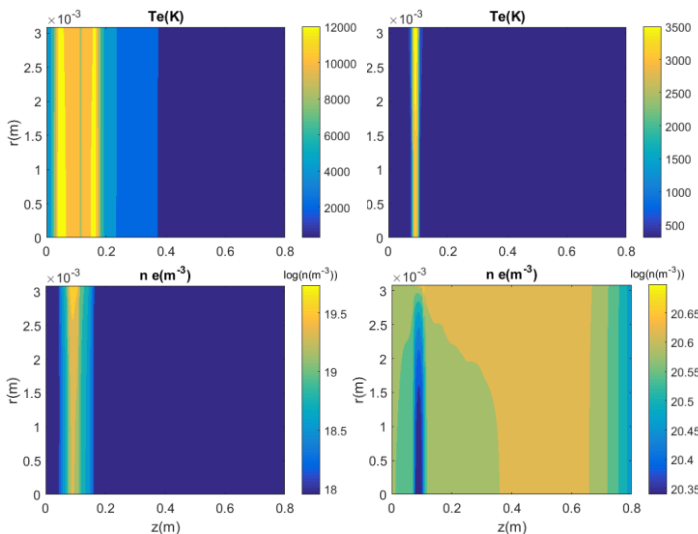
Surfatron



Ar vs Ar+SiCl₄

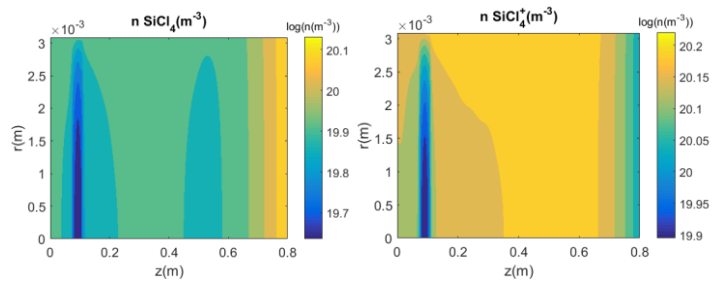
The discharge is simulated with an input power of 10W and an Ar flow rate of 215 sccm and a SiCl₄ flow of 0.5 sccm. The input power and the flow rate are reduced in comparison to experimental conditions.

Adding SiCl₄ to the discharge considerably decreases the electron temperature. The reason for this decrease is the increase of the electron density. The relatively small volume with a high electron temperature limits the energy transfer from the electrons to the heavy particles. Elastic energy transfer is the dominant loss term for the energy.



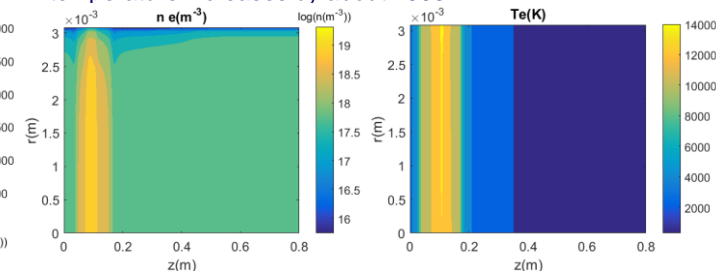
Densities of SiCl_x species

The current set of chemical reactions produces SiCl_x species that differ by about a factor 10. The species with the highest densities are SiCl₂ and SiCl₄. The ionic species reach values in the order of 10¹⁹-10²⁰.



Wall reactions

The current model is unstable when wall reactions are included for SiCl_x species. In a pure Ar plasma the effect of wall reactions is investigated. The electron density decreases considerably near the wall. The electron temperature increases by about 2000K.



Conclusion/Outlook

A first step towards modeling the Ar+SiCl₄ plasma is made. In the future it will be possible to model the experimental conditions when a self-consistent diffusion model is used instead of Fick's model. The model can further be improved by making the wall chemistry dependent on the deposited material.