Modeling Plasma–Dust Interactions in Argon CCRF Discharges

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Plasmas that contain dust, known as dusty plasma, are made up of electrons, ions, and charged solid particles. The dust can vary in size from nanometers to millimeters. These plasmas exist in nature, such as in space and planetary environments, and are also used in nanotechnology, microelectronics, and fusion devices.

The objective of this work is to study the effect of nanoparticles within plasma under different conditions. To achieve this, we will integrate the nanoparticles into the model, taking into consideration the fact that these particles become electrically charged within the plasma. This charge depends on the plasma parameters and, in turn, influences the surrounding plasma, resulting in a strong coupling of the equations.

To simulate a dusty radio-frequency argon discharge within a CCP reactor with dimensions following the PKE-Nefedov configuration [1], we will employ a one-dimensional fluid model using the Comsol 6.3 Software [2]. In this model, we will figure out the effect of dust nanoparticles on electron density, temperature, electric potential, and the dust charge number at different dust radius ranges. The results are compared to the findings from home-made simulations by Akdim et al [1]. Remarkably, a high level of agreement exists between the two sets of results.

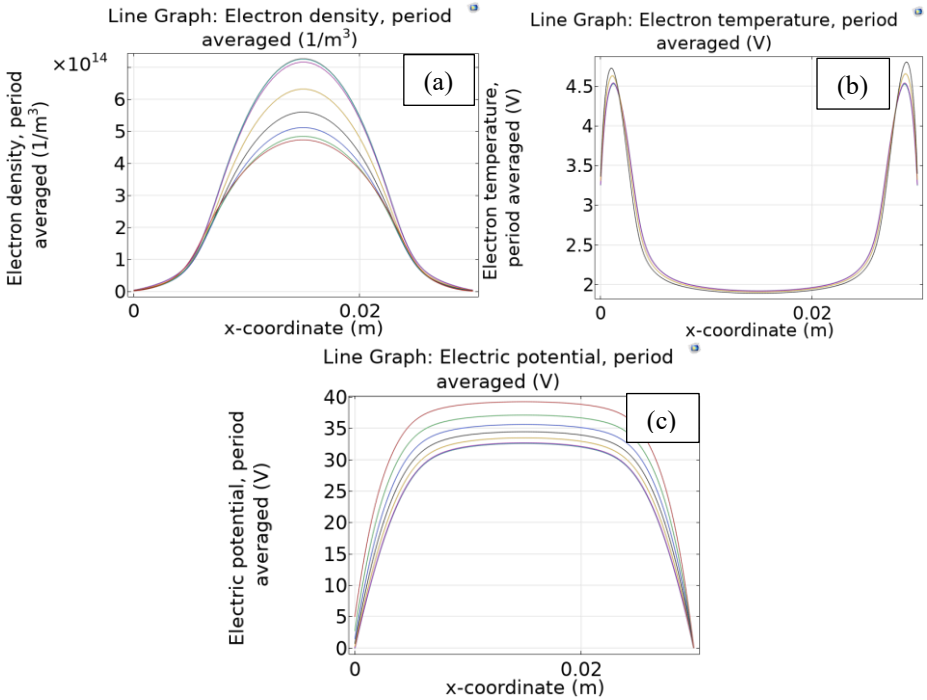

Figure 1 : *Electron density (a), temperature (b), and electric potential (c) variations for several values of dust density at radius rd=100 nm*

Références

[1] M.R. Akdim , and W.J. Goedheer, "Modelling of voids in colloidal plasma", Phys. Rev. E., 65, 015401 (R) (2002)
[2] COMSOL Multiphysics, v.6.3, COMSOL AB, Stockholm,Sweden

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