CHARACTERIZATION OF THE STARTING AND STABILIZATION PROCESSES INSIDE AN ELECTRODELESS LOW PRESSURE MERCURY LAMP DRIVEN WITH PULSED MODE SURFACE WAVES

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The low pressure mercury lamp is dominating the lighting market for decades. In these lamps the electrode loss is one the dominant factors that limit the efficacy of the lamp. Thus by removing the electrodes and sustaining the discharge with surface waves, the efficacy, which the lamp ideally delivers, can be obtained. In addition, with electrodes associated failure mechanism like the loss of emission materials or the darkening of the lamp bulb will also be eliminated. In this way it is possible to increase the efficacy as well as the lifetime of the lamp.

The surface wave technology for microwave discharge generation is already employed for many applications due to their stability and reproducibility in a wide variety of conditions such as excitation frequency and auxiliary gas pressure. Additionally the electromagnetic field components of the surface waves outside the plasma are evanescent, which helps drastically in the reduction of electromagnetic interferences. Despite these benefits the usage of guided surface wave discharges for lighting purposes is still an under-researched area.

The surface wave plasma produced in a pulsed mode is the main object of this research because of the possibility of using higher peak powers while maintaining a low average power. In this way a higher electron density and more intense emission lines can be obtained. However to obtain the best operation conditions for a high efficient light source, it is essential to characterize the transient processes in the plasma, like the advance of the ionization wave front and the evolution of the intensity of the emission lines.

In this work the starting and stabilization processes of plasma inside an electrodeless low pressure mercury lamp are studied by using a combination of electromagnetic and spectroscopic diagnostic methods. The variation of the ionization front velocity, the rise time of the electric field and lifetime of the afterglow along the plasma column has been determined under a range of rare gas hosts, different auxiliary gas pressures and input powers. The plasma columns have been produced with a wave-launching structure called Surfatron by an excitation frequency of 2.45 GHz.