SURFACE WAVE SUSTAIN DISCHARGE MODELING AT VARIOUS DISCHARGE GEOMETRIES AND WAVE MODES

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Surface electromagnetic wave travelling along dielectric–gas interface can produce plasma in the gas media, so called surface-wave-discharge (SWD). The plasma sustained by the propagation wave becomes in the same time a part of the wave-guide structure for further wave propagation. This wave-guide structure consists of different media one of which is plasma. In cylindrical geometry there are several configurations of SWD: 1) plasma sustained inside cylindrical tube like plasma-dielectric (p-d), plasma-dielectric-vacuum (p-d-v), plasma-dielectric-vacuum-metal (p-d-v-m) and other combinations of the different media; 2) plasma sustained in the outer side of cylindrical dielectric like dielectric-plasma (d-p), vacuum-dielectric-plasma (v-d-p), metal-vacuum-dielectric-plasma (m-v-d-p) which is a type of so called coaxial discharge ets.

The electromagnetic wave propagation along each of these wave-guide structures is described by the corresponding dispersion equation. The electrons in the plasma absorb the electromagnetic wave power and expend it in ionization and excitation collisions with the heavy particles, thus the wave power decreases along the wave-guide. The plasma produced in this way is axially inhomogeneous with almost linear decrease of the electron number density n_e from the wave launcher to the end of the plasma column. Because of the plasma axial inhomogeneity, the dispersion equation gives the dependence of the plasma frequency $\omega_p(n_e)$ on the wave number k at a fixed wave frequency ω, the so-called *phase diagrams*. The phase diagrams are usually presented in the form ω/ω_p as a function of dimensionless wave number $x = kR$, where R is the plasma radius. The form of the phase diagram strongly depends on the parameters determined by the discharge conditions. From phase diagrams behaviour it is possible to obtain information whether at the given conditions the plasma can be produced by the propagation electromagnetic wave or not.

The purpose of this work is to investigate theoretically the behaviour of wave phase diagrams at various discharge conditions and to find out values of plasma parameters at which the surface electromagnetic wave can produce plasma.