Dynamic profile formation of the helicon discharge

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Helicon plasma source, employing the helicon wave [1], is of current interest because of their promise in stably providing high-density (~ 10^{19} m^{-3}) and low electron temperature (~ a few eV) plasma under a wide range of parameters, e.g. device scale, magnetic field, neutral pressure etc. [2-4]. Due to these distinctive advantages, the helicon source is used for various applications, including plasma processing, nuclear fusion, electric thrusters, and space laboratory experiments [5].

Helicon plasma is generated by using the helicon wave, i.e., electromagnetic whistler wave in a bounded plasma. Over the past decades, researches on the helicon plasma have revealed some important mechanisms of efficient plasma production. The efficient power absorption can be partly explained by the strong collisional damping of the quasi-electrostatic wave called 'Trivelpiece-Gould' (TG) wave [6].

In our study, we have constructed the one-dimensional self-consistent model that includes the wave excitation, momentum equation, electron energy equation, and neutral dynamics, noting the balance between the source and loss fluxes. By using this model, we have certified several important temporal behaviors of the power absorption [7], the flux balance [7], density jumps [8] and the neutral dynamics [8] in the high-density helicon plasma, which are consistent with the experimental results [9]. In recent, we have also developed two-dimensional model to investigate the missing multidimensional effect. In our presentation, we will discuss the dynamic behaviors of helicon discharge in detail including the effect of the neutral dynamics.

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