

## Effect of the neutral depletion in helicon discharge

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Neutral depletion is a process in which neutral density decreases due to processes other than ionization. In the context of laboratory plasma sources, some experimental and theoretical studies suggest that the neutral depletion plays important roles in determining the plasma transport [1-3] and the maximum plasma density [1,4-6]. The neutral depletion is known to occur when the plasma pressure is comparable to the neutral gas pressure. If this is the case, the neutrals will naturally be cleared away from the region of high plasma pressure so that the net force balance is maintained. At the site of the neutral depletion, the drag force by the neutrals acting on the ions is reduced, letting the ions to escape the plasma readily. The result is an unexpected decrease in the plasma density as the input power is increased. Physical understanding of the neutral depletion may lead to a design of high-density helicon plasma sources not limited by the suppression of the maximum plasma density caused by the neutral depletion.

In our study, we have constructed the self-consistent fluid model to investigate the time evolution of the helicon discharge. Our model includes the wave excitation, the electron heating via collisional dissipation of excited waves, and the diffusion of charged particles. Also, we have included the neutral dynamics in our model and investigated the effect of the neutral depletion in the time evolution of helicon discharge.

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