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Compact Helicon Plasma Source for III-N Semiconductor Growth Reactive Nitrogen Species Production COSTEL BILOIU, XUAN SUN, ZANE HARVEY, RYAN MURPHY, EARL SCIME, Physics Department, West Virginia University — High plasma density and high ion exit flow speed make the helicon discharge potentially attractive for plasma assisted molecular beam epitaxy of III-N semiconductors. By a proper selection of the helicon wave phase velocity and input power it is possible to modify the electron velocity distribution function - thereby increasing the production of molecular excited species, which are favorable to the growth process, and decreasing the production of ionic species, which are detrimental for the epilayer. Further, the expansion of the helicon plasma into the diffusion chamber permits, through spontaneous radiative relaxation, the different N_2 triplet excited states to cascade down to the metastable $A^3\Sigma_u^+$ state. With a sufficiently long transit time to the expansion chamber, the long lived $A^3\Sigma_u^+$ state becomes the dominant reactive nitrogen specie in the plasma. Optical emission spectroscopy investigations in the diffusion chamber show that under certain working conditions, the N_2 first positive system ($B^3\Pi_g \rightarrow A^3\Sigma_u^+$, $\Delta v = 0$ at 1051 nm, $\Delta v = 1$ at 872.23 nm, $\Delta v = 2$ at 775.32 nm, and $\Delta v = 3$ at 654.48 nm) bands, are the dominant transitions in expanded, nitrogen, helicon-generated, plasma.

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