HIGH POWER ELECTRODELESS PLASMA PROPULSION USING NONLINEAR HELICON WAVES

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Helicon plasma propulsion systems are a recent development in plasma propulsion that uses high intensity rf helicon (whistler waves) to create the plasma. Such systems have several advantages. They are electrodeless and therefore not subject to erosion at high power operation. Helicons are known to create high density plasmas so that for a fixed thrust level, helicon plasma propulsion system can be very compact. In this paper we discuss results of the High Power Helicon (HPH) being developed at the University of Washington. This system can be operated over at least two orders of magnetic in power which adds to its versatility. At high power (100 kW) it operates in a non-linear wave regime where the wave field intensity is comparable to the background field required to support the whistler waves. This regime enables the creation of very dense plasmas at 10^{21} m^{-3} with high specific impulse of 2000 s for argon and even higher Isp for lighter gases at nearly 100 percent gas efficiency. At these density and energies the plasma can be considered high beta so that detachment issues from the guide magnetic field is not a problem. The high beta characteristics of the systems also facilitate the usage of magnetic nozzles to provide a highly focused plasma stream with the bulk of the plasma thermal energy converted to directed beam energy. This ability to focus the plasma stream aids in the overall power efficiency of the system and leads to other applications beyond a simple thruster, including beamed plasma propulsion systems.

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