Figure 8

. Computed power density dissipated in the plasma (a), total dissociation rate of N2 (b), space- and time-averaged helium metastable density (c) and electron density (d) for different fundamental driving frequencies and numbers of consecutive harmonics, N, obtained from the simulation. The measured helium metastable densities are also shown for comparison in (c). The vertical dashed lines indicate exemplary (fundamental) driving frequencies (f0) for the single- and multi-frequency VWT scenarios at which the same power density is dissipated in the plasma. The corresponding horizontal dashed lines in plots (b) - (d) indicate the corresponding N2 dissociation rate, He metastable and electron density obtained at these (fundamental) driving frequencies at identical power dissipation. The peak-to-peak value of the driving voltage is kept constant at 500 V and the He flow is 1000 sccm with an N2 admixture of 0.1 %.

Experimental data are marked as Experiment

Simulated data is marked as Simulation

f0 [MHz], Power density [W cm-3]

(Figure3a)

Simulated power density dissipated in the plasma for N2-admixture of 1 sccm and different applied frequencies of 12MHz, 14MHz, 18MHz and 28MHz respectively with N=1 and 12MHz, 14MHz, 18MHz and 30MHz with N=2 and 6MHz, 10MHz, 12MHz, 14MHz and 18MHz respectively with N=4.

f0 [MHz], Total dissociation rate of N2 [1016 cm-3 s-1]

(Figure3b)

Simulated total dissociation rate of N2 for N2-admixture of 1 sccm and different applied frequencies of 12MHz, 14MHz, 18MHz and 28MHz respectively with N=1 and 12MHz, 14MHz, 18MHz and 30MHz with N=2 and 6MHz, 10MHz, 12MHz, 14MHz and 18MHz respectively with N=4.

f0 [MHz], He\* [1011 cm-3]

(Figure3c)

Simulated space- and time-averaged helium metastable density for N2-admixture of 1 sccm and different applied frequencies of 12MHz, 14MHz, 18MHz and 28MHz respectively with N=1 and 12MHz, 14MHz, 18MHz and 30MHz with N=2 and 6MHz, 12MHz, 13.56MHz and 18MHz respectively with N=4.

[Dashed] Experimental space- and time-averaged helium metastable density for N2-admixture of 1 sccm and different applied frequencies of 12MHz, 14MHz, 18MHz and 28MHz respectively with N=1 and 12MHz, 14MHz, 18MHz and 30MHz with N=2 and 6MHz, 10MHz, 12MHz, 14MHz and 18MHz respectively with N=4.

f0 [MHz], Electron density [1011 cm-3]

(Figure4d)

Simulated electron density for N2-admixture of 1 sccm and different applied frequencies of 12MHz, 14MHz, 18MHz and 28MHz respectively with N=1 and 12MHz, 14MHz, 18MHz and 30MHz with N=2 and 6MHz, 10MHz, 12MHz, 14MHz and 18MHz respectively with N=4.