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Qualitative theory of multi-hollow microwave plasma source IVAN GANACHEV, Shibaura Mechatronics Corporation, IJI LIANG, HIDEO SUGAI, Chubu University — The performance, in particular uniformity, of planar surface-wave plasma sources can be enhanced by modifying the dielectric- plasma interface to include an array of hollows cut into the dielectric ("multi-hollow plasma source"). Recently[1] we found that with increasing overall power the number of ignited hollows increases, but the power absorbed by each one of them remains almost constant for fixed gas type and pressure (about 7 Watt per hollow in Ar at 1.3 Pa and 2.45 GHz). In the present contribution we propose an explanation to this behavior: We show that small plasma-filled hollows have a discrete spectrum of resonance densities. In the particular case of small hemispherical hollows, the electron density of the n-th mode is $n_e(n) = n_c[1 + \epsilon_d(2n + 1)/2n]$, $n = 1, 2, \ldots$, where n_c is the cut-off density and ϵ_d is the dielectric constant of the plate carrying the hollows. This spectrum is rather narrow (from 5 to 7 times n_c for the aforementioned example). Once the highest resonance density is reached in all currently ignited hollows, any additional power spills over and eventually ignites one of the remaining hollows. With sufficient power, the discharge expands uniformly to all hollows.

[1]Sugai et al.: *Proc. 7th Int. Workshop Microwave Discharges: Fundamentals and Applications, Hamamatsu 2009, p. 85*

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