High Frequency Gas Breakdown and Microplasma Formation in Evanescent-Mode Cavity Resonators

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***Abstract*— Electronically-tunable evanescent-mode (EVA) cavity resonators have recently attracted a lot of interest due to their wide range of tunability, narrow instantaneous bandwidth, low insertion loss, high quality factor, and relatively small size. This type of resonator stores the majority of electric field energy in a micron-sized gap and its essential characteristics have resulted in a number of unique and high-performance adaptive filters. Several applications such as satellite communication systems, base-station transmitters and radars require high power transmitting to increase the coverage and system performance. Two different issues may influence the high-power behavior of EVA resonators: a) non-linear electromechanical effects and b) RF gas discharge. Non-linear electromechanical effects are important in a tunable EVA resonator only when it includes a flexible diaphragm whose deflection controls RF gap size! and consequently its resonant frequency. Specifically, when the RF field in the critical RF gap becomes comparable to the bias force applied to the diaphragm, non-linear effects may dominate its performance. On the other hand, gas breakdown due to strong RF electric field affects both static and tunable EVA resonators. Gas breakdown causes plasma formation which is electrically conductive and leads to degradation in performance by shifting the resonant frequency and/or increasing its insertion loss by eroding the micron-size-gap forming electrodes. In this talk, we review gas breakdown in both static and tunable EVA cavity resonators with micron/nano-sized critical gaps. Plasma simulations are performed to investigate the breakdown power and the post-breakdown conditions and the results are experimentally validated by high power measurements.**