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Plasmas for Reconfigurable Radio-Frequency Systems[1]

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The presentation discusses properties of weakly ionized plasmas from the standpoint of their potential application to tunable and reconfigurable radio-frequency (RF) electronics: antennas, resonators, filters, limiters etc. Plasmas have important advantages in comparison with other (e.g. semiconductor, ferrite etc.) solutions, especially in high-power regimes. Although the RF applications motivate the plasma research, the focus of this presentation is on the relevant fundamental aspects. First, we show that plasmas can combine resistive, capacitive, and inductive properties and that all three can be tuned over very wide ranges. We then discuss recent proof-of-principle experiments on using simple gas discharges as tunable elements in resonant LC filters, resonators, and limiters. We then turn to plasma antennas and show that such antennas generally have lower gain than metallic antennas do, but the cross-coupling between different elements of an array is also lower, which is an important plasma advantage. Finally, we discuss the critical problem of Johnson-Nyquist noise and show that although conventional plasma antennas can be very "noisy", sustaining the plasma by nanosecond repetitive pulses could enable low-noise plasma antennas.

[1]Abbas Semnani and Dimitrios Peroulis (Purdue University, School of Electrical and Computer Engineering) are co-authors of this work. This work was funded in part by the National Science Foundation.