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Plasma-Based Electrically Small Antennas[1] ABBAS SEMNANI, SERGEY MACHERET, DIMITRIOS PEROULIS, Purdue University — The demand for wideband electrically small antennas (ESA) is rapidly growing because of (1) the need for compact multi-function devices and (2) the limited space available in many applications. In an ESA, the frequency dependent antenna impedance consists of a very small resistance and very large reactance, which makes impedance matching networks necessary. However, implementation of such a matching network over a wide frequency bandwidth using conventional passive elements is impossible due to the Gain-Bandwidth limitation. Therefore, non-Foster matching networks with a negative capacitor/inductor are usually employed for wideband matching. Although active and metamaterial-based non-Foster matching networks have been introduced, those are complicated, lossy, and cannot handle high power. Cold plasma is a medium that can exhibit tunable negative permittivity at sufficiently high electron density and at the same time can handle high power and temperature. We show that plasma augmentation can substantially increase the efficiency of small antennas over wide frequency range, and thus plasma-augmented high-power and wideband electrically small antennas can be a viable solution for efficiently transmitting high powers, particularly over low frequencies.

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