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Variable-Frequency Capacitively Coupled Discharge as Tunable Impedance Element for RF Systems[1] ANDREY KHOMENKO, SERGEY MACHERET, Purdue University — Plasmas are attractive for next-generation reconfigurable RF electronics because plasmas can be turned on/off, have their properties varied in a wide range, and handle much higher power than semiconductors can. Tunable capacitors and inductors are key elements of any reconfigurable system. Previously, a DC discharge in abnormal glow regime was shown to provide tunable capacitance for an LC resonator due to the sheath thickness variation with current. In this work, capacitively-coupled RF discharge in the alpha regime was operated in air at 1 Torr at a constant voltage in a wide range of frequencies, 10-300 MHz. The impedance characteristics and the sheath and plasma parameters were inferred from current and voltage measurements. At frequencies below about 100 MHz, the sheath thickness turned out to be inversely proportional to the driving RF frequency, so that the capacitance was proportional to the frequency, in good agreement with theory. At very high driving RF frequencies, the sheath impedance becomes negligible, and due to negative permittivity of the plasma, the overall impedance becomes inductive. Thus, the variable-frequency alpha-mode discharge can be used as a widely tunable capacitor or even be switched from capacitor to an inductor. Such a tunable element can be operated at frequencies different from the driving (i.e. plasma-generating) frequencies.

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