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Nonequilibrium Plasmas Confined to Microcavities: New Opportunities in Plasma Science and Its Applications*

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The recent development of devices in which nonequilibrium, low temperature plasmas are spatially confined to cavities having cross-sectional dimensions as small as 10×10 μm^2 offers new avenues of inquiry in plasma science and its applications. Characterized by plasma volumes of typically nanoliters or less and specific power loadings of the plasma of tens of kW-cm^{-3} to $\geq$ 1 MW-cm^{-3}, these microcavity plasma devices offer access to a previously unexplored region of plasma parameter space. In particular, nonequilibrium plasmas operating continuously with a plasma frequency of 1 THz and at number densities approaching that of a supercritical fluid appear to be attainable. In this presentation, the seminal characteristics of microcavity plasmas with characteristic dimensions below 100 μm, as well as several of their photonics applications, will be discussed. The latter include the realization of microplasma arrays as large as 250,000 devices, the observation and characterization of photodetection in the ultraviolet, visible, and near-infrared with atmospheric pressure microplasma, and an optical amplifier in the blue ($\sim$460 nm) excited by a microplasma array. *Work supported by the U.S. Air Force Office of Scientific Research.