



MICROCAVITY PLASMA SCIENCE AND RECENT APPLICATIONS: BOUND-FREE COUPLING, TRANSISTORS AND ILLUMINATION

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Abstract

Recent progress in the science and technology of low temperature plasmas confined to microcavities has provided a pathway to new optoelectronic devices, including hybrid plasma/semiconductor transistors and lighting in the form of thin sheets. When bounded by a cavity having dimensions no larger than $500\ \mu\text{m} - 1\ \text{mm}$, microplasmas exhibit unique properties including operation as a stable glow at atmospheric pressure and with power loadings of 10s to 100s kW/cm^3 . The common ancestry of the e-h plasma in semiconductors and the e-ion plasma in the vapor phase has long been recognized. By coupling e-h and e-ion plasmas across a potential barrier with a strong electric field, we have realized a hybrid plasma/semiconductor phototransistor known as the plasma bipolar junction transistor. Having a silicon emitter and base but a gas phase plasma serving as the collector, npn PBJTs exhibiting gains as large as 10 have been demonstrated. Optical coupling between linear microchannel plasmas in an array of parallel channels has been observed and attributed to an optogalvanic effect. This mechanism provides a means by which individual microplasmas in a large array can be modulated. Thin, flat, and lightweight microplasma based lighting is being developed. Available as "lighting tiles" up to 8" x 8" these lamps are spatially uniform to 5% with luminous efficacy approaching 30 lumens/W.

About the Speaker: J. G. Eden received the B.S. from the Univ. of Maryland, and the M.S./Ph.D. from the Univ. of Illinois. Dr. Eden has 250 publications and 35 patents, and is Fellow of the IEEE, OSA and APS. He was Editor-in-Chief of the IEEE Journal of Quantum Electronics and president of IEEE-LEOS. Dr. Eden has received the LEOS Distinguished Service Award, IEEE Third Millennium Medal the IEEE/LEOS Aron Kressel Award, the C.E.K. Mees Medal of the OSA, and the Harold E. Edgerton Award of SPIE. He was recently the Fulbright-Israel Distinguished Chair in the Natural Sciences and Engineering.