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Focused Laser Initiated RF Sustained High Pressure Air Plasmas[1] YAN LI, JOHN SCHARER, Department of Electrical and Computer Engineering, University of Wisconsin-Madison — Measurements and analysis of air breakdown processes and plasma production were done by focusing 193 nm, 300 mJ, 15 MW high power laser radiation inside a helical RF coil. We observe quantum resonant multi-photon and collisional cascade laser ionization processes that produce high density (ne$\sim$5*10^{15}/cm^3) cylindrical seed plasmas. We installed an improved capacitive system that better matches the antenna impedance before plasma is produced, which increases the breakdown pressure from 20 to 60 torr with 5 kW incident RF power only. The focused laser and associated shock wave produces a plasma seed for sustaining by the RF (1-10 kW, 0.5-1.8 s) pulse. We find that triggering 20 ns multi-laser pulses at 20 Hz during one RF pulse increases the breakdown pressure from 70 to 85 torr single laser pulse. Measurements of the helical RF antenna plasma-loaded impedance are obtained by measuring the complex reflection coefficient with and without the laser pulse. Additional diagnostics are obtained with a 105 GHz interferometer to measure plasma density, collision frequency and electron temperature. Spectroscopic measurements of the plasma and comparison with the SPECAIR code are made to determine rotational and vibrational neutral gas temperatures. The results demonstrate that the laser formed seed plasma allows RF sustainment at higher initial air pressures than with RF only initiation.

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Yung-Ta Sung
Department of Electrical and Computer Engineering,
University of Wisconsin-Madison

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