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Focused Laser Initiated, RF Sustained, High Pressure Air Plasmas YAN LI, JOHN SCHARER, University of Wisconsin-Madison — Measurements and analysis of air breakdown processes and plasma production were carried out by focusing 193 nm, 300 mJ, 15 MW high power laser radiation inside a Pyrex chamber surrounded by a 6 cm diameter helical RF coil. We observe quantum resonant multi-photon (REMPI) and collisional cascade laser ionization processes that produce high density ($n_e \sim 5*10^{15}/cm^3$) cylindrical seed plasmas. The focused laser and associated shock wave produces a plasma seed for sustainment by the RF (1-10 kW, 0.5-1.8 s) pulse. The laser seed plasma increases the air RF breakdown pressure from 60 torr to 85 torr with 5 kW incident RF power and in lower pressure conditions the laser decreases the time between firing the RF pulse and formation of plasma. We also observed that the two capacitor settings in the matching system are important in determining the breakdown pressure and plasma parameters. To diagnose the inductive ($\sim 10^{12}$/cc) and capacitive ($\sim 10^{11}$/cc) plasmas with different properties, we use our 105 GHz (mm wave) 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, vibrational and neutral gas temperatures. A directional coupler in the RF system is applied to obtain the incident and reflection RF signals, with which we can calculate both magnitude and phase of the reflection coefficient and determine via FFT methods the time dependent plasma impedance.

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