Abstract Submitted
for the GEC14 Meeting of
The American Physical Society

Inductively-coupled plasmas in pure O_2: measurements of densities of O atoms, electrons and vibrationally excited Omolecules MICKAËL FOUCHER, LPP-CNRS UMR 7648, EMILE CARBONE, CEA grenoble, JEAN-PAUL BOOTH, PASCAL CHABERT, LPP-CNRS UMR 7648, LPP-PLASMAS FROIDS TEAM — Inductively-coupled plasmas containing O_2 (pure or mixtures) are widely used in materials processing. Various simulations have been developed but experimental validation is still sparse. We present here a comprehensive data set for O_2 plasmas over a wide range of pressure and RF power to address this need. The plasma is excited with a 4-turn planar coil through a dielectric window at 13.56 MHz in an anodized aluminium reactor. The electron density was measured with a microwave resonator hairpin probe. It increases continuously with RF power, but with pressure it passes through a broad maximum around 40 mTorr. Ground-state O atom densities were determined using Two-Photon Absorption Laser-Induced Fluorescence combined with absolute calibration using Xe TALIF. The atom density increases with gas pressure, but with RF power it first increases but progressively saturates tot about 20% of the initial (no plasma) gas density. A novel high-sensitivity ultra-broad-band absorption spectroscopy setup allowed O_2 molecules to be detected in high vibrational states (up to v = 18) via the Schumann-Runge bands. Molecular Ovibrational temperatures up to 12,000K were observed, whereas the rotational temperature did not exceed 500K. This indicates that electron-impact pumping of vibrational levels is important, whereas V-T transfer is slow. These processes must be included to accurately model the O_2 plasma system.

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Date submitted: 15 Jun 2014 Electronic form version 1.4