Development of Quench-Free fs-TALIF Diagnostic for Atomic Nitrogen Detection in High-Pressure NRP Discharges

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Résumé

The development of a femtosecond two-photon absorption laser induced fluorescence (fs-TALIF) technique for performing ground state measurements of atomic nitrogen inside a nanosecond repetitively pulsed (NRP) discharge is presented herein. Measurements are performed for a wide range of pressures (p=0.1 - 10 bar), the main goal being to develop a quench-free diagnostic that facilitates the study of the kinetic mechanisms responsible of N production/recombination in NRP discharges. Experimental results accompanied by TALIF modeling show that quench-free measurements can be performed only if the laser fluences is high enough such that the rate of photoionization (by a 2+1 REMPI scheme) is higher than the rate of quenching to the metastable state. In this case, the population of the 2-photon excited state can be decayed very quickly during the pulse so that there is no signal left to decay by quenching after the pulse is over. Under these conditions, the typical calibration method (by using a noble gas) is not feasible anymore. Instead, a new calibration technique based on synchrotron VUV direct absorption is proposed.