VACUUM UV LIF MEASUREMENTS OF RO-VIBRATIONALLY EXCITED HYDROGEN MOLECULES IN A SUPERSONIC PLASMA EXPANSION

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Rotationally and vibrationally excited hydrogen molecules are measured using Laser Induced Fluorescence (LIF) spectroscopy in the vacuum-UV. The laser radiation is generated via the Stimulated Anti-Stokes Raman Scattering (SARS) process, and is tunable between 120 nm and 230 nm. Up to 10 Anti-Stokes beams are simultaneously directed into the hydrogen plasma expansion. This so-called multiplex excitation makes an accurate wavelength calibration of the pump laser imperative. This calibration is performed by simultaneously recording the VUV-LIF signal from the plasma expansion and the well-known two-photon laser induced fluorescence spectrum of nitric oxide in a gas cell[a]. The density of hydrogen molecules in the ro-vibrationally excited energy levels is calibrated on the basis of previously performed Coherent Anti-Stokes Raman Scattering measurements. Population distributions are measured in an expanding plasma to determine the production mechanism of the ro-vibrationally excited hydrogen molecules.

In this contribution we present results on the population distribution of $\mathrm{H}_2^{\mathrm{r,v}}$ from $\mathrm{v} = 2$ to $\mathrm{v} = 6$ in the electronic ground state. The ro-vibrational population distribution in the expanding hydrogen plasma can be described with a two temperature Boltzmann distribution. The population distribution in the low rotational levels ($J \leq 5$) in the measured vibrational states can be described with a temperature of 800 K, while the higher rotational levels are populated according to a *vibrational-like* temperature of 3600K. In the $v = 2$ state rotational excitation is observed up to $J = 19$. A possible generation mechanism for the *super-rotational* excitation is the association of atomic hydrogen at the reactor wall.

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