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Time and space-resolved detection of NH and NH2-Radicals in a RF-driven microdischarge via planar laser induced fluorescence and pulsed cavity ring-down spectroscopy

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In order to understand common processes for surface modification it is crucial to know the concentration and spatial distribution of the most prominent intermediates. In case of the amination of various polymers the most important species are assumed to bethe NH and NH_2 radical. In our setup a micro-structured electrode (MSE) is used to generate a RF-driven glow discharge in different mixtures of argon and ammonia at pressures between 10 and 100 mbar.
Two well-established spectroscopic techniques are employed to obtain the absolute concentration as well as the spatial distribution of the radicals.
The spatial distribution can be determined using a PLIF setup where a lasersheet is introduced to the plasma area. An intensified CCD-camera is used as a position sensitive detector. Time resolution is limited by the laser pulse width, which is between 3-5 ns. To minimize the influence of the plasma emission a 5 ns gate is used for the image intensifier and band pass filters are mounted in front of the lens. This approach provides access to relative radical densities. A second method is needed to measure absolute quantities.
Absolute concentrations were obtained with a CRDS setup without any means of calibration. The setup consists of two dielectric mirrors forming an optical resonator and a photo multiplier tube for detection. Thorough grounding is necessary to prevent electromagnetic pickup of the plasma frequency. CRDS delivers the average concentration in the line of sight. This data can be used to calibrate the LIF image.
A Nd-YAG pumped dye laser system is used for excitation. NH radicals are detected at 336 nm ($A\ ^3P \leftarrow X^3S^-$, v(0,0)) whereas the ($\tilde{A}^2A_1 \leftarrow X^2B_1$) transition around 598 nm is used used for NH_2.

Keywords
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