Electron-impact induced fluorescence – a versatile method in modern spectroscopy

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Spectra of electron-impact induced fluorescence from noble gases and small molecules were recorded with an collision energy of 3.5 keV intending their application for wavelength calibration. The presented spectra within the range of 40 – 312 nm are in good agreement with previously measured and calculated spectra. Nearly all observed lines could be identified including 196 new lines.

Electron-impact induced fluorescence is a fundamental process in atomic and molecular physics. Quantitative experiments are important to validate theoretical models of electron-atom or electron-molecule interactions in various fields of physics, e.g. discharges, plasmas, controlled nuclear fusion or astrophysics. Electron impact excitation of gaseous samples is widely used to investigate excitation cross sections in dependence of the collision energy [1].

To overcome the lack of calibration sources in the EUV/VUV region electron-impact induced fluorescence was proposed as a transfer standard for calibration of EUV/VUV fluorescence spectrometers [2,3]. Typically, a multitude of excited states is caused by the collision induced excitation with fast electrons, which is comparable to polychromatic excitation by electromagnetic waves resulting in a vast number of fluorescence lines.

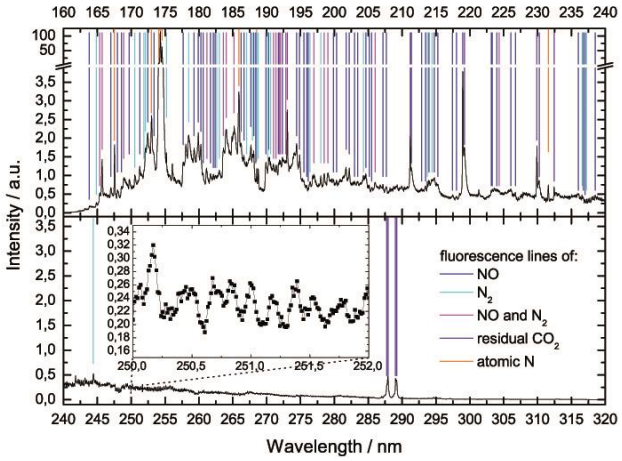

Fig. 1:3.5 keV electron impact induced fluorescence of N_2O in the wavelength range from 160 nm to 320 nm. Indicated are the identified lines of fluorescence from fragment species [5].

In a first series of experiments all stable noble gases were investigated with 3.5 keV kinetic energy electron-impact induced fluorescence spectroscopy (EIFS) in the spectral range from 165 to 312 nm [4]. The results can be used as calibration standards for later measurements. The so far not published lines have been assigned employing the differences of energy levels given by the NIST-ASD. As an example for small molecules the EIFS spectrum of N_2O is depicted in Fig.1. With the presented measurements the fluorescence spectrum of N_2O is expanded into the UV [5]. We will present that the versatile method of electron-impact induced fluorescence is applicable for studies of ionization levels and fragmentation channels of gaseous samples.

References:
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