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Chapter 1

Spectral Analysis

A relevant aspect to study DBD discharge in air is what species are produced during the discharge. Various studies observed the typical spectrum when there is a DBD discharge in air ([**DBDair_Trot**], [**DBDAirTypicalSpec**]), meanly it presents peaks relative to reactive species from water, oxygen, nitrogen and its oxides at visible wavelenght, from 200 to 880 nm.

We are intersted in plasma that contains molecules involved in blood coagulation mechanisms, Reactive Oxidant Species (such as hydroxil radical OH) and Reactive Nitrogen Species (derived from nitric oxide NO) ([**6153386**]). In this spectroscopy study is given particular attention to them and their precursor, i.e. the presence of transitions relative to hydroxil, oxygen and molecular nitrogen.

1.0.1 Emission theory and measures

It's important to stress out that, with this measuring method and due to complexity of plasma reactions and composition, it's not possible to extrapolate quantitative considerations between different species concentration. However it's possible to make some considerations watching spectra variation with different experimental setup.

To it's used a spectrometer that collects light from a point near plasma exit. Spectrometer, how it works, different gratings, efficience for wavelenghts.

An intersting parameter is the working distance between source's head and target. To see how spectrum varies along plasma plume, it is taken in two different positions:

- position 1, as close as possible to plasma exit point

Reactions that produce and recombine reactive species, and consequently density and lifetime of species, are influenced by electric field and duration of the discharge. The study about species abundance in spectra is made varying source parameters of amplitude and frequency of the pulse.

General theory on molecolar excitation and notation. What's found, what not and why. Different lines at different windows.

Immagini/plasmaemission.jpg

Figure 1.1: Rapresentation of radiation emission [**book:291477**].

Immagini/apparato.jpg

Figure 1.2: Setup of the experiment: there is the working source, the metal target and the optical setup on the left.

1.0.2 Line recognition

NO

OH

$\mathbf{N_2}$, $\mathbf{N^+}$

1.0.3 Different discharge parameters

Peak's intensities. How they varies with different parameters. Different intensities and dynamics for different species. OH => Varying intensities N2 rot => // N2 vib => //

1.0.4 Estimation of plasma temperatures

T_r **OH**

T_r **$\mathbf{N_2}$**

T_v **$\mathbf{N_2}$**

Temperature estimation for gasses and for vibr species, explanation of rotational and vibrational temperature and fit methods.

Spectrum with different gasses?

Immagini/spettrotot_unico_label_def.png

Figure 1.3: Spectrum with an helium flow of 2 L/min, pulse parameters of $f = 5\,\mathrm{kHz}$ and $\Delta t = 16\,\mu\mathrm{s}$, optical position 1, near plasma exit

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