Pockels cell for Plasma (APPJ)

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Optics and photonics
Thesis advisor: Prof. Dr. Thomas Nelis
Expert: Dr. Gerardo Gamez (Texas Tech University)
Project partner: Texas Tech University, Lubbock

The proposed project consists of designing a system to measure the charge deposition on a substrate through interaction with the APPJ (Atmospheric Pressure Plasma Jet) and studying its role in the desorption process. The principle of the electro-optic effect will be used for measuring the surface charge deposited by the APPJ. An overview of a transmission-type experimental setup for such measurements includes several components depicted.

Introduction

Recently, there has been an increased interest in atmospheric pressure plasma jets (APPJ) in several fields. Unique applications of such plasmas have been developed in fields from materials processing to water disinfection to biological tissue treatment. In particular, APPJ's are carving a niche in surface chemical analysis when combined with mass spectrometry because they are simple to use and construct, cost-efficient, portable, and allow desorption and ionization of species of interest thus obviating the need for sample preparation and permiting analysis in real-time.

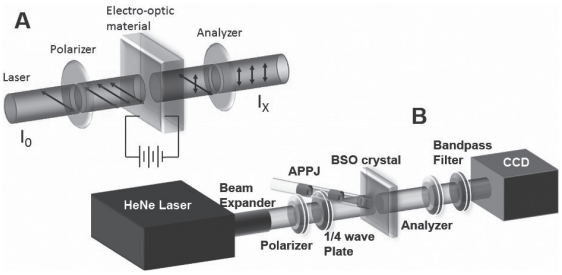
Project description

The charge deposition of the APPJ onto a substrate will be measured by means of the electro-optic effect [166–171]. This technique has been previously used to assess the interaction of plasmas with dielectric barriers in configurations important for plasma displays and biological tissue treatment. In short, a beam of polarized light is passed through an electro-optic material which acts as a wave plate in the presence of an electrical field. Thus, by placing an analyzer after the electro-optic material one can monitor the phase difference induced by the electrical field. In this manner, the charge deposited on the surface of an electro-optic material can be measured because it generates an electric field across the material. After proof-of-concept studies, the system will be used to study the effect of APPJ operating conditions (voltage, current waveform, plasma gas flow rates, electrode geometry, etc.) on the temporal evolution and distribution of the charge deposited. This will be correlated to the ion intensities measured through mass spectrometry.

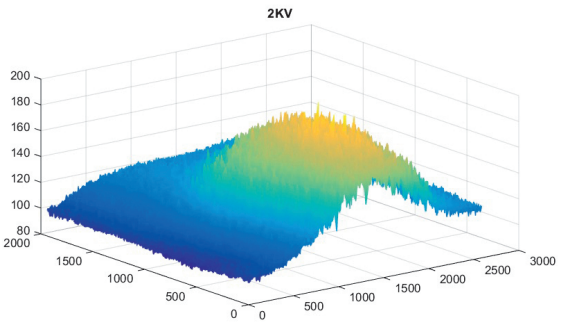
Work description

The first step of my Bachelor work was to get familiar with the different optical elements, the BSO crystal, the plasma and the Pockels effect. Once this theoretical steps are completed, the following tasks have to be realized:

- Design opto-mechanical train
- Assembling
- Automation of power supply to elecrodes, calibration BSO crystal
- Automation of plasma control (HV, gas flow)
- Synchronization of discharge (plasma) and CCD camera



Electro-optic system (schematic)



3D intensities of the laser

Thibaud Allaman
thib_allams8@hotmail.com