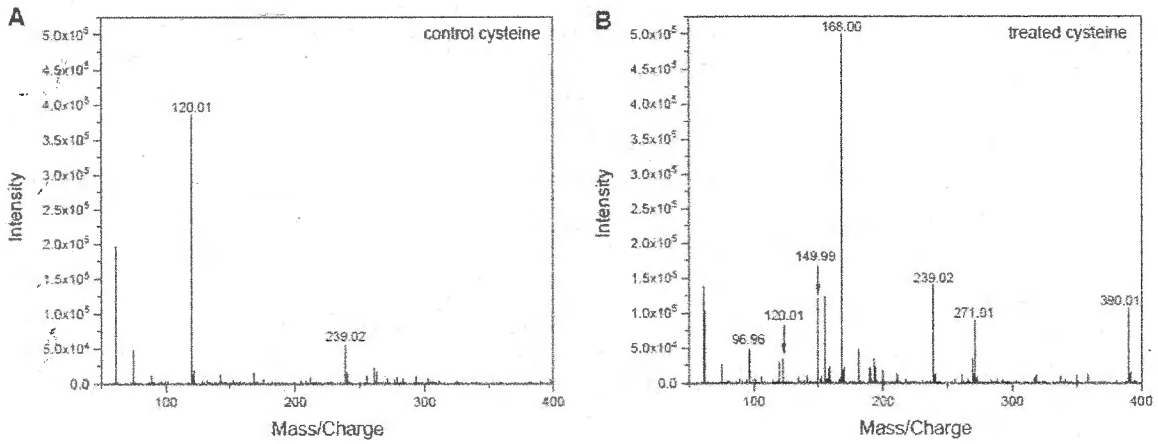

Figure 1. MS spectra of cysteine solutions (300 μM) acquired before (A) and after plasma treatment (B). Treatment conditions: 5 minutes, 3 slm Ar/N2/O2 feed gas (99-0.5-0.5%).

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Generation Of Reactive Species By Plasma Needle In Different Liquids

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Plasma activated media (PAM) is produced by exposing liquids to cold atmospheric plasmas [1,2]. PAM has gained increasing attention due to its capacity to kill cancer cells as effectively as direct treatment of cells in culture by cold plasmas.

In previous works [3] we could show the selectivity of an atmospheric pressure plasma needle on osteosarcoma cell lines versus healthy bone cells. The cytotoxicity of the direct plasma treatment on cells was comparable to treatment with PAM, wherein in this case the liquid selected was cell culture medium.

The rationale beyond employing PAM lies in being able to avoid the effects of electrical field, or UV/VIS radiation present in plasmas, and its biological effects seem to lay in the reactive oxygen species (ROS) and reactive nitrogen species (RNS) generated in the aqueous state. The concentration of ROS and RNS in the PAM is directly related to its effectiveness in killing cancer cells. It is our interest to evaluate the different parameters influencing the generation of ROS and RNS.

In this work different liquid media (different cell culture media, aqueous solutions such as water or ringer's saline, etc.) are compared, and the production of ROS and RNS is quantified in different conditions (volume of liquid, treatment times, distance to the nozzle). The stability of the mentioned species is evaluated with time.

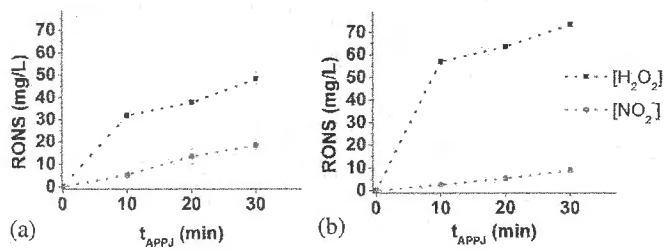

Figure 1. Production of H_2O_2 and NO_2^- by APPJ treatment on different cell culture medium (a) McCoy and (b) AdvDMEM.

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Investigations Of A Helium Plasma Jet In Interaction With Biological Liquids

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For the plasma medicine community it is of high interest to understand the physicochemical mechanisms concerning the effects of plasmas on living cells and cancerous cells, in particular. A first step is to study the effects produced upon biological liquids, as they represent the exchange environment for most biological process. After plasma exposure of liquids, minor changes of the basic parameters such as pH, ionic strength or chemical composition can lead to a major biological impact. Thus, this indirect effect of plasma treatment on cells behaviour must also be addressed during plasma cancer studies, together with direct exposure.

In this context, the present experiments are focused on the plasma production and transfer of oxygen and nitrogen reactive species to a liquid target, e.g. ultra pure water or phosphate-buffered saline. The plasma source consists of a helium plasma jet in a barrier discharge configuration, operated at atmospheric pressure which interacts with solutions up to 40 minutes. Electrical and optical monitoring of the plasma jet was performed over the entire exposure duration, using high speed techniques, in order to assess the plasma jet warm-up period and settling time [1], with and without liquid target. Molecular beam mass spectrometry of the jet confirmed the presence in the various negative and positive ions based on oxygen and nitrogen species [2].

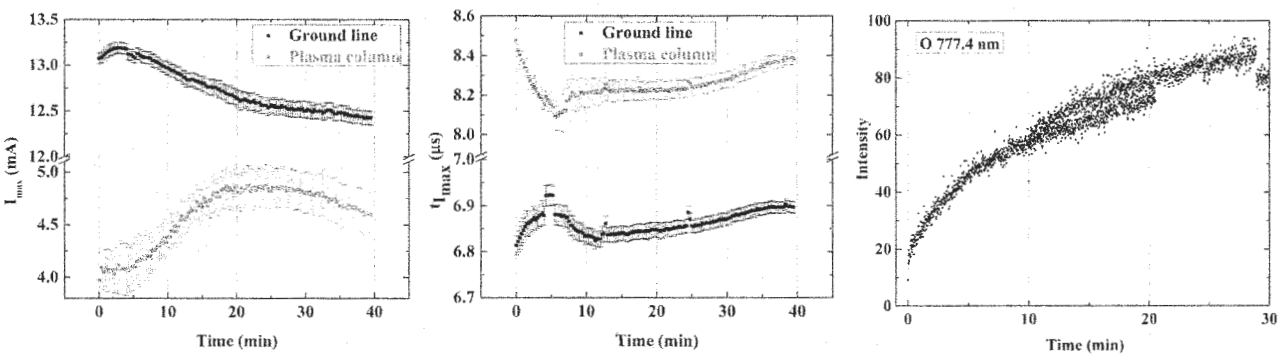

Figure 1. Influence of elapsed time on peak values of the current (I_{max}), time (t_{Imax}) and O (777 nm) line integral intensity.

The ultraviolet absorption spectra of liquids, in the 200 - 400 nm wavelength range, were acquired immediately after exposure and they were repeated up to 14 days, in order to monitor the liquid chemistry evolution. Using spectral deconvolution, we monitored the variation of absorption bands corresponding to the following species: O_2, NO_2^-, NO_3^-, H_2O_2 and O_3. We observed an increase of the O_2 and NO_2^- bands, while the absorption bands related to all other species remain unchanged.

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