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The effect of a cold atmospheric pressure plasma jet on DNA

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Synopsis In this study, we have investigated the interaction of a 'cold' Atmospheric Pressure Plasma Jet (APPJ) with dry plasmid DNA. The plasmid DNA is observed to be very sensitive to short-term exposures to low energy electrons, ions and excited neutral species as well as to UV light, which are all components of the APPJ fed by helium. In order to determine the mechanisms that lead to strand breaks in the DNA, the APPJ exposure was carried out over a range of operating conditions.

Recently there has been increased interest in the use of non-thermal atmospheric pressure plasmas (see Fig.1) as a tool in medical applications [1] e.g. in surgery and dentistry. However, most of these applications are still in an early stage of their development mainly due to the lack of fundamental knowledge of plasma interactions with living tissue at both a macro- and a microscopic level.

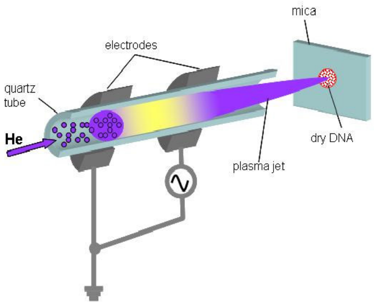

Figure. 1. The experimental set-up.

In order to obtain a better understanding of the effect of 'cold' plasma on bio-molecules, we have exposed plasmid DNA to a helium plasma generated using a non-thermal atmospheric pressure plasma jet. Damage to the DNA induced by plasma exposure was determined by gel electrophoresis for different irradiation times. The amount of undamaged DNA molecules decreased by 30-60% after 10 sec of irradiation (see Fig.2).

The distance between the tip of the visible plasma jet and the DNA was varied (see Fig.2). It was found that initially damage fell off rapidly with distance but damage was still observed more than 10 cm from the jet. We have also explored damage as a function of helium flow rate and the amount of UV light.

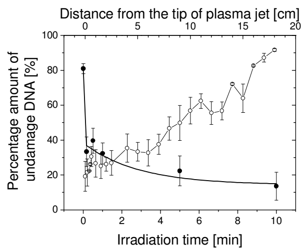

Figure. 2. The percentage amount of undamaged plasmid DNA as a function of irradiation time (closed circles) and distance of a sample from the visible plasma (open circles).

Recently we have started studies on effect of water and proteins on DNA damage using plasma exposure. We expect that the presence of water will increase the damage to DNA due to the formation of highly reactive radicals during the APPJ interaction. In contrast the presence of proteins around DNA molecules may shield them from the plasma-generated species and so reduce the amount of damage. Results will be reported at the conference.

References

[1] Fridman G, Friedman G, Gustol A, Shekhter A B, Vasilets V N, Fridman A 2008 *Plasma Process. Polim.* **5** 503-533

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