Preliminary study of the argon gas flow from an atmospheric plasma jet applicator

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A project to study the atmospheric plasma jet produced from a small applicator has been started through a collaboration between Quantemol Ltd. and Creo Medical Ltd. The aim of the project is to obtain a detailed understanding of the spatial and energy distributions of ions and plasma species leaving the applicator and to understand their role in any anti-microbial effect.

To initiate this project, flow simulations of the bulk neutral gas (argon) has been undertaken. This step was taken to help guide the design of the applicator itself and to optimize the spread of the gas flow. These simulations were achieved by using the gerris flow solver [1] which implements a finite element/volume method [2]. To enhance computational time axial symmetric simulations were produced, with the symmetry axis running along the center of the pin inside the applicator. The simulation domain is shown in figure 1, where the left hand side is defined as an inflow using parameters supplied by Creo Medical Ltd. and the upper and right hand sides are defined as outflow boundaries. The resulting scaled argon concentration is shown in figure 1, where red equates to unity and blue to zero. These simulations have also been extended to look at the interaction between multiple jets and different applicator shapes.

Using these simulations we have been able to outline possible changes which can be made to the applicator design. Further simulation results (i.e. three dimensional flows) will also be reported at the conference.

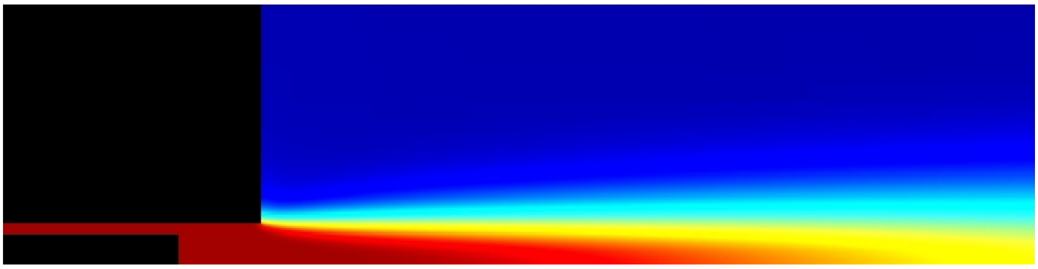

Figure 1: *Image of the argon concentration flowing from the end of the plasma jet applicator*

References

[1] S. Popinet, "Gerris: A tree-based adaptive solver for the incompressible Euler equations in complex geometries," J. Comput. Phys. 190, 572, 2003
[2] J. Donea and A. Huerta. Finite Element Methods for Flow Problems. Wiley, 2003.