voltage and the time averaged current with a resolution of 0.1 kV and 10 µA, respectively. The second one is a HV power amplifier TREK® 20/20C (± 20 kV, ± 20 mA, 20 kHz) driven by a signal generator. An internal current sensor makes it possible to visualise current. This sensor have a precision of about 10 µA and bandwidth of 10 kHz.

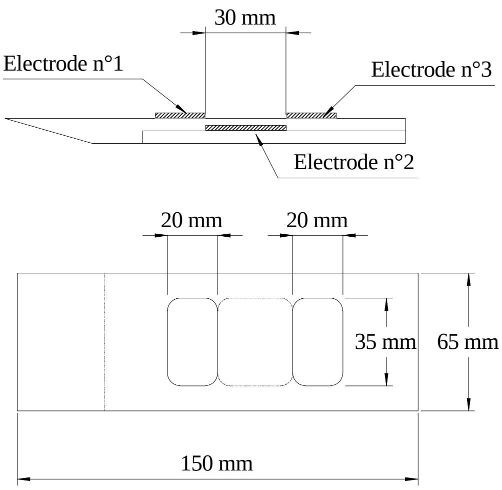

Figure1 : Schematic represetation of electrodes configuration

We use two slidinng discharge created by two configuration (figure 2). The first one is created by appliying positive AC voltage on the electrode n°1 and a negative DC voltage on electrode n°2 and n°3. This is the configuration n°1. In the second configuration, the positive AC voltage is applied on the electrode n°3, the negative DC voltage is applied on electrode n°2 and n°1. This is the configuration n°2. The difference between these two configurations is the position of the positive AC electrode which in the first case is placed upstream and in the other case downstream.

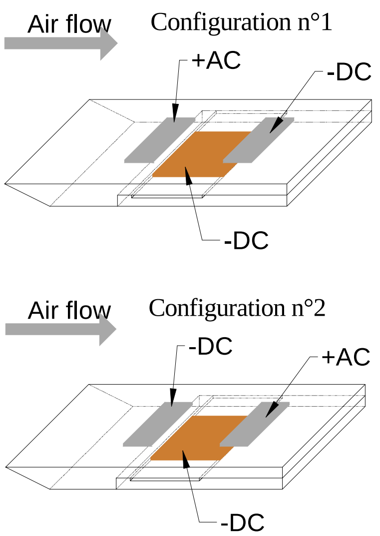

Figure 2: Schematic represention of the two configuration used.

III. Result and Discussion

The figure 3 shows discharge current in function of time in the presence of the flow and without flow. Theses measurements were made with the internal sensor of the H.V. amplifier. Without flow one observes a capacitive current due to the presence of the H.V. cables and the electrode arrangement. There is no discharge and no current peak. With the same electric conditions, a current peak appears when the flow is running. Only these peaks are representative of the discharge current. They appear on the one hand because of the pressure decrease and on the other hand because of the presence of the air flow. An increase in the current results in an increase in the amplitude of the peaks and an increase in the number of peak during an alternation.

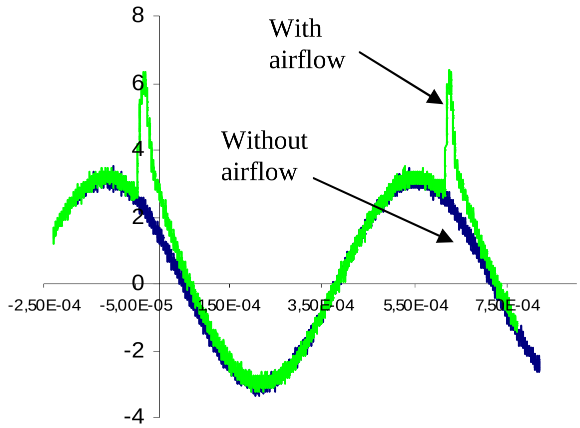

Figure 3: Current (mA) versus time with configuration n°1, f = 1500 Hz, vAC =0/+8, vDC = -4 kV, with and without air flow

We can see on the figure 4 the difference of current measured with air flow and without airflow. That makes it possible to isolate only the part of current due to the presence of the discharge. If we compute the average during one period of this difference, one finds the value of the current given by the second HV power supply. One notes an error ranging between 6 and 20% following the representativeness of the selected period. This shows us that the average value of current delivered by the HV DC power supplied is representative of the amplitude of these peaks as their number. Thereafter we will use this mean values.

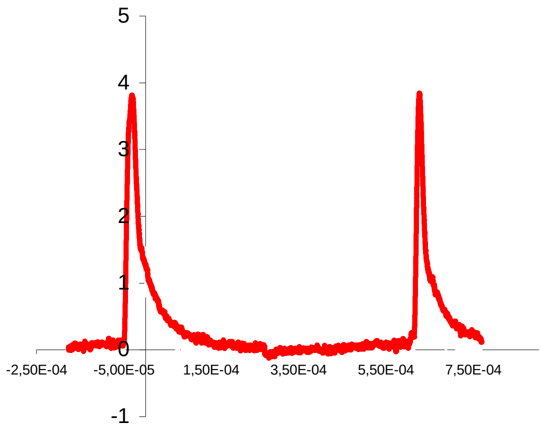

Figure 4: Current diffence versus time betwen the case with and without airflow. Configuration n°1, f=1500 Hz, v AC =0/+8, vDC=-4 kV, with and without air flow

Figure 5 shows the mean discharge current value in function of fréquency of positive AC voltage with airflow. The configuration used is the configuration n°1, negative DC voltage is equal to -4 kV, maximum voltage of AC voltage is 8 kV. It is observed that the mean discharge current increases linearly with the frequency. More the frequency amplifies more the average current increases.

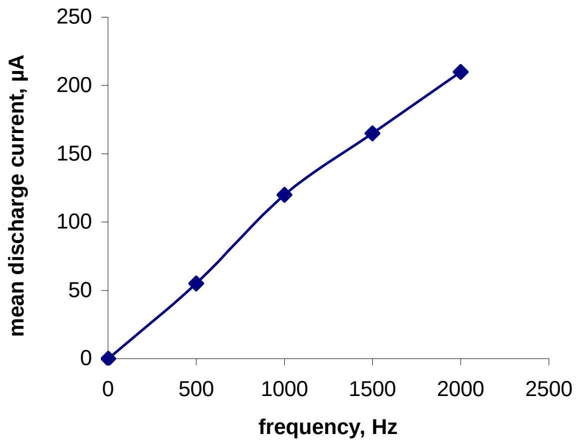

Figure 5: Mean current versus frenquency. Configuration n°1, vAC =0/+8, vDC=-4 kV, M = 1.8

Figure 6 shows the mean discharge current value in function of positive AC voltage with airflow. The configuration used is the configuration n°1, negative DC voltage is -4 kV, frequency is 1500 Hz. We can observe that more the HV amplitude increases, the minimun being maintained to 0 kV, more the mean discharge current value increases. We could not increase the AC high voltage, if one exceeds 12 kV the discharge changes mode and becomes an arc.

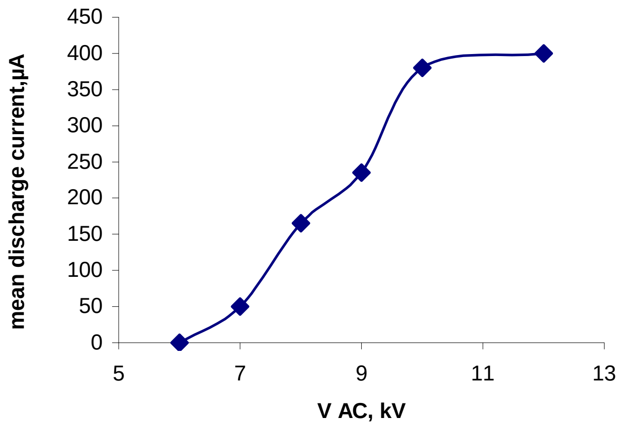

Figure 6: Mean current versus positive AC voltage. Configuration n°1, f=1500 Hz , vDC=-4 kV, M = 1.8

Figure 7 shows the mean discharge current value in function of negative DC voltage with airflow for configuration n°1 and configuration n°2. Maximum voltage of AC positive voltage is 8 kV, frequency is 1500 Hz.

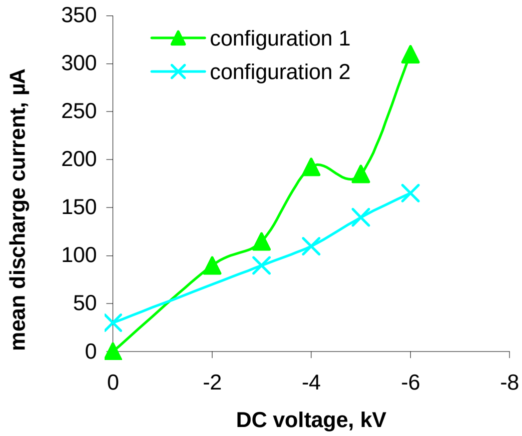

Figure 7: mean discharge current versus negative DC voltage with airflow for configuration n°1 and configuration n°2. vAC = 8 kV, f=1500 Hz.

In configuration 1 the AC positive voltage is applied upstream. We observe that more the negative DC voltage increases more the mean discharge current increases. It is the same observation in case of configuration n°2, when the AC positive voltage is applied downstream. But in this case mean current values are weaker. This shows that position 2 (when the anode is placed downstream) is more unfavorable, may be because the migration of positive charges from the downstream electrode to the upstream electrode is slowed down by the presence of the flow. This comportement in the case of continuous discharge in the presence of subsonic flow was already observed [14]

IV. CONCLUSION

We have shown that it is possible to obtain a stable surface discharge in presence of supersonic air flow (M=1.8). This discharge can be effectively used because she allows us to obtain large surface plasma and because she does not pass to the arc.

We have shown that more the voltage différence betweeen anode and cathode increases, more the mean discharge current value increases. We have oberved that the discharge current increases when the frequency increases.

In the next work we have to observe aerodynamics effects of this kind of discharge.

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