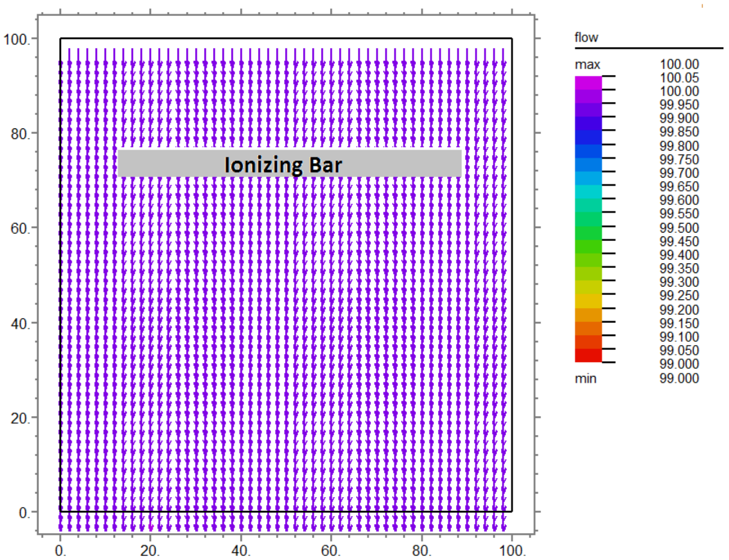
TECHNICAL NOTE

Differential Airflow & Ionizer Performance

As standards and advisories for electrostatic control for the semiconductor and electronics industries become more restrictive, questions have arisen regarding ionization specifications and performance. With electrostatic discharge (ESD) of growing concern for the high tolerance manufacturing processes, specifications for devices have driven ionization requirements as well. However, ionizer design and performance have always depended upon close tolerances for environmental conditions in critical applications.

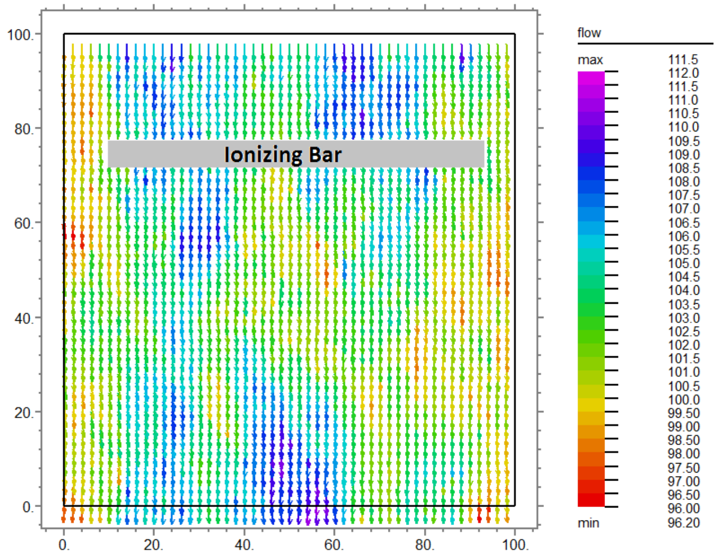
Laminar Airflow

In truly laminar airflow environments (which are rare, despite claims), the uniformity of airflow across an ionizer without air assist (CDA) can produce very accurate end-to-end balance as measured with a Charged Plate Monitor (CPM). The figure below shows laminar flow rate of 100LFPM with an ionizer embedded to discharge elements in the lower chamber.

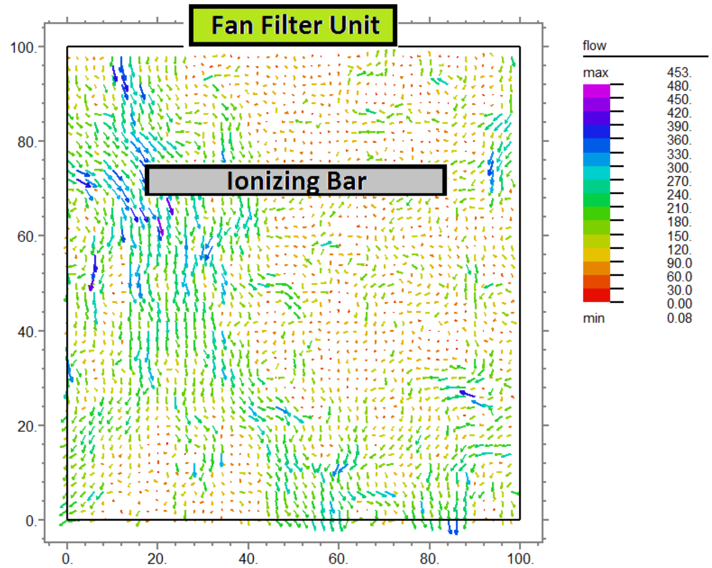


Differential Airflow

When even small differences in laminar airflow occur, transport via airflow from the ionizer to the Charged Plate Monitor can be affected, causing differences in ionizer balance and discharge time. In the figure below, a small difference of only 2 LFPM in the chamber air input (100 LFPM) can lead to differences in airflow velocity throughout the chamber. This is not usually significant for production parameters, but can cause differences in ionizer performance across the bar.



When major differences in airflow occur, in this case for a processing tool chamber, ionizer performance can be quite non-linear. In addition, ionization coverage for areas of the chamber will differ from each other as well based upon differential airflows. In the example below, modeled from an actual application, a single fan filter unit (FFU) was installed for vertical airflow that did not span the full chamber width. The gap on the left side of the FFU had a linear airflow measured at 120 LFPM. Directly under the FFU, airflow was measured at 70 LFPM. The gap on the right side of the FFU was measured at 100 LFPM. As can be seen, airflow velocity and direction was very non-linear. This made it very difficult to balance the ionizer for the product being handled.



Solution

The solution is to impose a more linear airflow on chamber conditions so that ion delivery to the discharge target can be made as uniform as possible. There will always be non-linear components of airflow, but ionizers appropriate for these applications can also be supplied with CDA or N2. This creates a calibrated delivery gas flow from each ionizer nozzle, overcoming the differences in chamber airflow velocities. Of course, distance from ionizer to ionization target also is a factor. The longer the distance for ions to travel in a non-linear airflow environment even with CDA or N2 assist, the more ion balance and discharge will be affected.

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