doi: 10.1017/S1431927609093064
Microsc Microanal 15(Suppl 2), 2009

Contamination Removal Rates Improved by New Impedance Matching Network for the Evactron® De-Contaminator

Christopher G. Morgan, Ross Bernheim, and Ronald Vane

XEI Scientific, Inc., 1755 E. Bayshore Rd., Suite 17, Redwood City, CA 94063

The Evactron® De-Contaminator (D-C) removes hydrocarbon contamination from electron microscopes [1]. A radio frequency (RF) generated plasma is attached to the microscope chamber; room air or other oxygen containing gas passes through the plasma. This process creates oxygen radicals which ash the hydrocarbons within the electron microscope. There needs to be an impedance matching network, or match, near where the RF plasma is generated. The match is used to maximize the power delivered to the plasma inside the electron microscope chamber. The Evactron D-C uses a compact match, seen as the silver labeled box in Figure 1. The design of this particular match, used by XEI Scientific from 2003-2008, had several shortcomings. The matching network can require user adjustment via a trimmer cap. The match was not ventilated, so the components would become hot. The reflected power, *i.e.* power flowing from the plasma back to the generator, would have values typically between 10-20% of the power delivered to the plasma.

The new match design, seen in Figure 2, changes the circuit topology for increased efficiency. A second tunable element is added to allow for improved matching on both the input and output. The new design operates at higher power levels with concomitant reduction in power component stresses. Rather than using commonly available parts, special components are used to reduce losses. All components in the signal path are derated significantly. Ventilation is added to the case to help reduce power component temperatures. With these improvements, the reflected power has values typically between 0-10% of the power delivered to the plasma.

Tests were performed similar to those reported previously [2] in order to compare the cleaning efficiency of the old and new designs. Mechanical pump oil was deposited onto two quartz crystal microbalances (QCMs) by placing them in a small chamber (cylindrical, height = 14 mm, diameter = 20 mm) next to a port opposite the vacuum line. A tube is attached to the port on one end; on the other end of the tube is attached a leak valve used to flow a small amount of air into the chamber. Pump oil was placed inside the tube. The chamber was pumped down and the leak valve was adjusted so that a small amount of air flowed into the chamber. When heat was applied to the tube, pump oil started to deposit onto the QCMs. Around 500 Å of pump oil was deposited on the QCMs, both of which are then moved to a larger test chamber roughly 15 cm from where an Evactron D-C was installed. The rate of decontamination, or loss of the hydrocarbon layer from the QCMs, was measured for both matches, which are run so that the forward RF power measured by a Bird meter in line with the RF power line is 10 W. The pressure of the vacuum chamber was set to 0.4 Torr during plasma cleaning.

There is observed a dramatic improvement in cleaning efficiency with the new design, as seen in Figure 3. This increase is due to lower reflected power, leading to greater efficiency in creating oxygen radicals. In the first two runs, the old match was used for ~20 minutes each run. On

average, the cleaning rate for the old match was around 2 Å/minute. For the next two runs, the new match was used, also in ~20 minute runs. The average cleaning rate for the new match is around 4 Å/minute, twice as fast as the old match. The old match was then reinstalled, and the test was rerun with the same results as previously seen with the old match.

References

[1] http://evactron.com/technical.html
[2] Morgan, Christopher G., Gleason, Mark M. and Ron Vane, Microscopy Today 15 (5) (2007) 22.

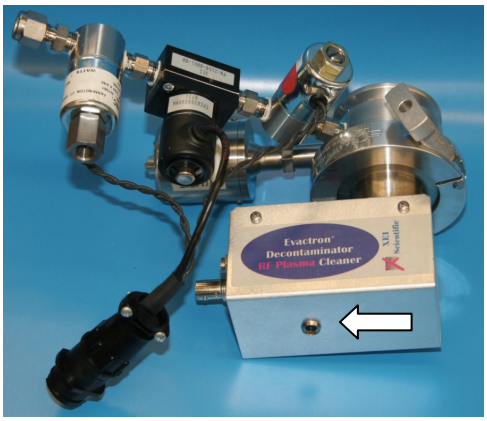

Figure 1: Old impedance matching network, or match (silver box with label) attached to valve and pressure gauge assembly. The arrow points to the trimmer cap needed for tuning of match by user.

Figure 2: New impedance matching network, or match. Note ventilation holes and two black match adjustment holes. Tuning of the match is made at the factory and these holes are sealed before shipment. No match adjustments are made by the user.

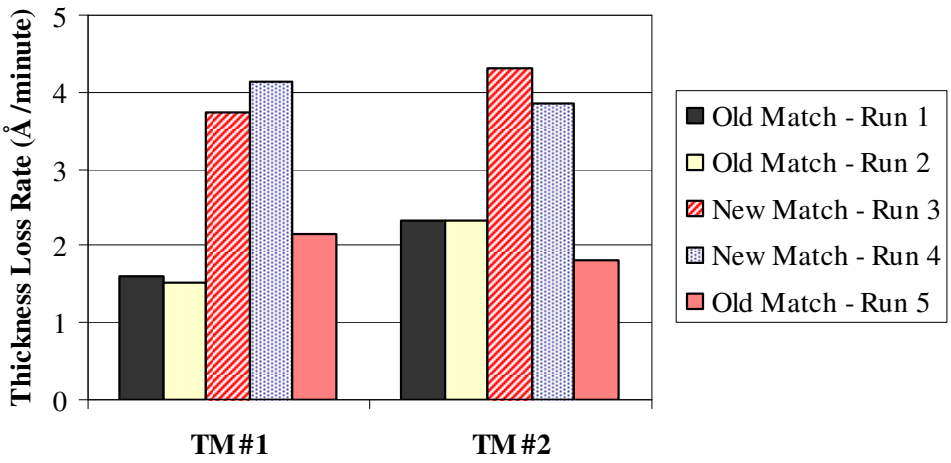

Figure 3: Results from tests on both matches using a quartz crystal microbalance to measure thickness loss rates of pump oil 15 cm from Evactron De-Contaminator. All measurements were made with chamber pressure at 0.4 Torr and forward RF power delivered to match at 10 W, as measured by a Bird meter. The two quartz crystal microbalances used for this test are referred to as TM#1 and TM#2.

https://doi.org/10.1017/S1431927609093064 Published online by Cambridge University Press