INFICON

TECHNICAL NOTE

Detecting Contamination in a Transfer Chamber by a CVD Chamber using FabGuard®

FabGuard Sensor Integration and Analysis System is a fully automated, real-time early fault detection and analysis system for improving semiconductor equipment and process productivity and various INFICON *in situ* diagnostic sensors. The powerful analysis techniques of FabGuard are capable of "smart diagnostics" by combining sensor and tool data for fault detection and classification. FabGuard puts *in situ* sensors to work to:

- Baseline normal process and tool behavior
- Analyze process data in real-time to detect problems and pinpoint problem sources
- Issue warnings and alarms

One benefit of using FabGuard is to combine data from an advanced sensor (an INFICON RGA in this case) with data from the process tool. In this example, an RGA was used to monitor the transfer chamber where wafers are moved into and out of process chambers. There were a total of four process chambers. Chambers 1 and 2 were CVD (TiN using TDMAT). Chambers 3 and 4 were PVD (Al). The main objective of FabGuard in this case was to detect contamination of the transfer chamber by certain species generated in the CVD chambers. This type of contamination could poison the PVD chambers.

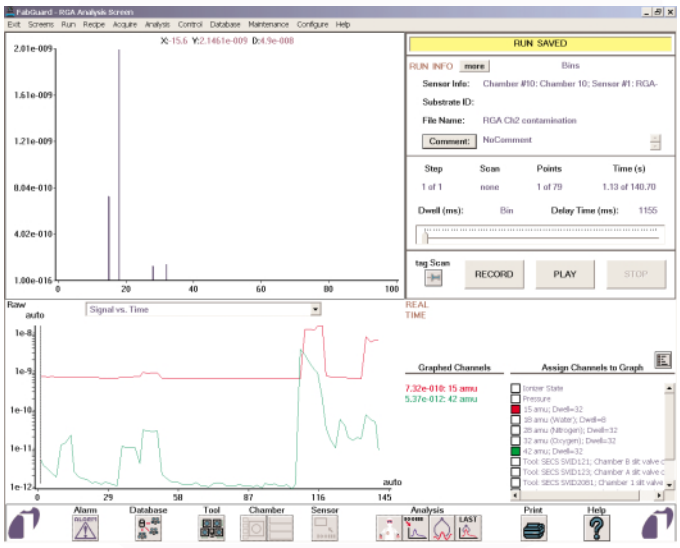

Figure 1. RGA data for several wafers moving through the Transfer Chamber. Masses 15 and 42 are plotted.

Figure 1 shows RGA data for several wafers moving through the transfer chamber. Two RGA Sensor Bins are selected for plotting: mass 15 (red) and mass 42 (green). Both of these masses are byproducts of TDMAT decomposition during the CVD process that are monitored by the RGA. The chemical composition of TDMAT is $Ti(N(CH_3)_2)_4$. The chemical composition of the two plotted masses is: CH_3 for mass 15 and NCH_2CH_4 for mass 42. Both of these masses are much higher (around 110 seconds) than at any other time. The vertical axis scaling is logarithmic, so the increases around 110 seconds are quite large.

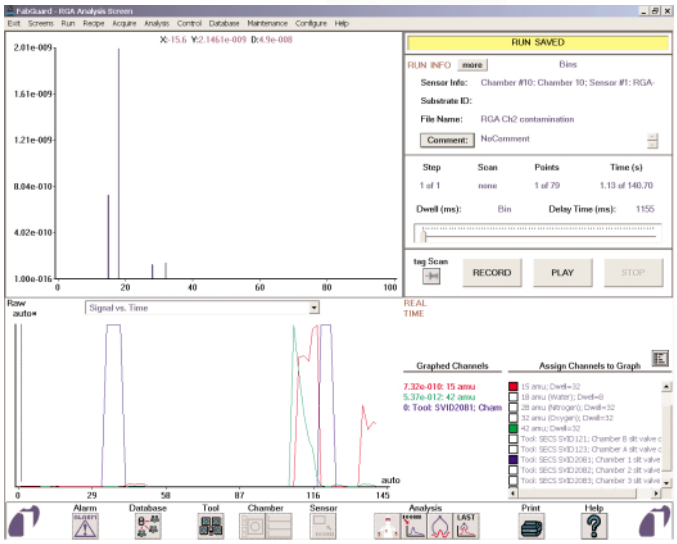

Figure 2. RGA and Tool data for several wafers moving through the Transfer Chamber. The Tool data shows that the contamination did not occur when the slit valve to CVD Chamber 1 was open.

HOW FABGUARD WORKS

The increases in CH_3 and NCH_2CH_4 around 110 seconds are large enough to be considered a fault. The question now becomes: which CVD chamber is the culprit? Figure 2 is similar to Figure 1, except that data for the Tool Bin that tracks the open/close state (1 or 0, respectively) of the slit valve between CVD chamber 1 and the transfer chamber is plotted in addition to the two masses. Also, the vertical axis scaling is now linear and each bin has its own scaling. This scaling makes it easy to compare things that have very different magnitudes. CVD chamber 1 is obviously not responsible for contaminating the transfer chamber. Figure 3 shows that CVD chamber 2 caused the contamination.

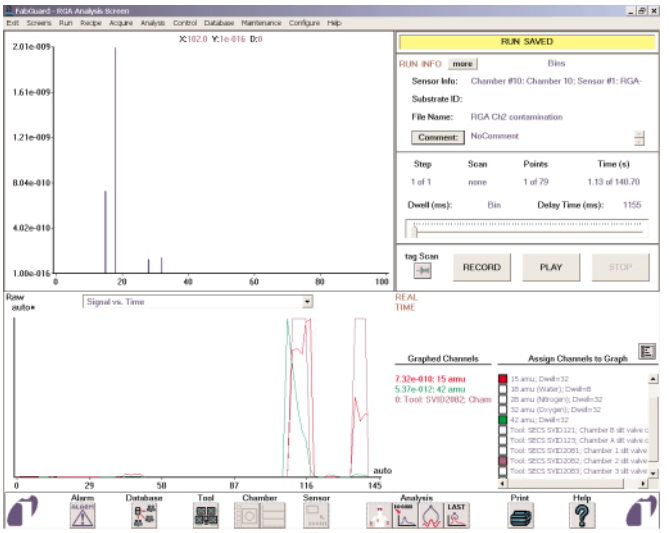

Figure 3. RGA and Tool data for several wafers moving through the Transfer Chamber. The Tool data shows that the contamination occurred when the slit valve to CVD Chamber 2 was open.

Figure 4 shows the settings for the Math Logic Analysis that FabGuard used to detect this fault. The logic is defined so that a fault is generated if mass 15 is above 1e-8 or mass 42 is above 1e-9 when the slit valve to chamber 2 is open. This condition must be true for 2 or more consecutive data points to be considered a fault. A persistence of 2 consecutive data points was chosen to allow for variability in the collection rates of the RGA and Tool data. This is marked as a moderate fault (yellow alarm) because the detection levels are low enough that immediate shutdown of the tool is not required.

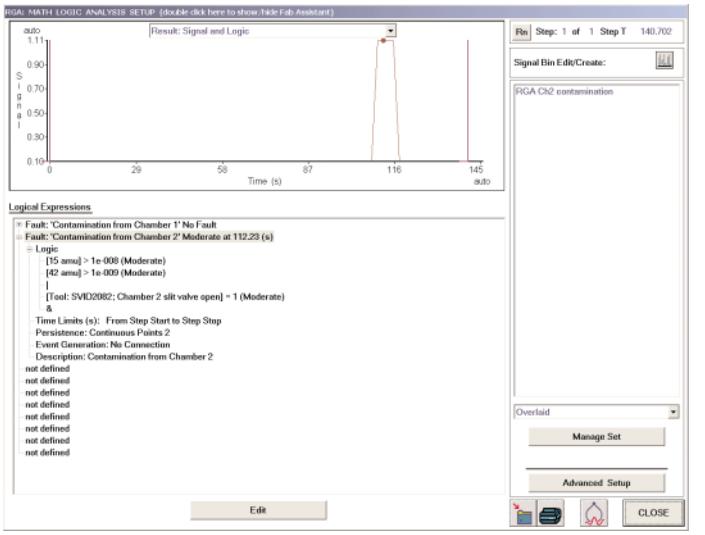

Figure 4. Analysis logic used to detect contamination of the Transfer Chamber by CVD Chamber 2.

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GLOBAL HEADQUARTERS:

Two Technology Place, East Syracuse, NY 13057 USA
Tel: +1.315.434.1100 Fax: +1.315.437.3803 E-mail: reachus@inficon.com

UNITED STATES FRANCE GERMANY LIECHTENSTEIN SWITZERLAND UNITED KINGDOM CHINA JAPAN KOREA SINGAPORE TAIWAN

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