



Trace and Purity Analysis for Gases and Chemicals

Suhas Ketkar

Welcome to another Podcast from Air Products.

Hello, I'm Ed McKendry, and I'm here today with Suhas Ketkar, the manager of Electronics Analytical Technology and Technical Services with Air Products. Suhas has been with Air Products for 15 years and the focus of his work has been trace and purity analysis for gases and chemicals. Before Air Products, Suhas worked for 5 years for an analytical instrument company. Today Suhas holds a PhD in physics and a Masters of Technology Management from the Wharton School of the University of Pennsylvania. He's a published author of over 25 articles all focusing on the detection of low levels of impurities for semiconductor materials. Suhas, welcome to the show and thanks for being with us.

Thank you, Ed.

Well Suhas, can you tell us why is it important for customers to analyze for trace impurities in semiconductor materials?

As the design rooms are shaping the semiconductor processes are more sensitive to trace levels of contaminants and gases and chemicals that are used. Moreover the new ITRS roadmap is calling for even stringer specification for some of the chemicals and gases that are going to be used in the future processes.

So can you give us a couple of examples of the issues that the industry and the customers are facing?

Currently, there's a drive towards lowering the temperatures used in the epitaxial growth processes. As the temperature is lowered, it is becoming clear that the processes are more sensitive to low levels of moisture. Another example is Gallium Nitride fabrication for blue and white LEDs. Gallium Nitride processes are very sensitive to low levels of moisture, oxygen, and other oxygen containing species that are present in the ammonia used to fabricate Gallium Nitride. A third example is the use of 193 nanometer lithography). At this wave length even minute levels of hydrocarbons present in the purge gases used to purge the lithography tools can fragment into carbon and deposit the carbon onto the very expensive lenses used in lasers of these lithography tools.

So can you tell me specifically about Air Products expertise in this area?

We have a large group devoted towards developing new analytical methods and techniques for low level detection of impurities. Most of the personnel working in the group are physicists and chemists who understand the interactions of atoms and molecules which is very critical to develop new techniques to detect these atoms and molecules in semiconductor materials. We have expertise in optical spectroscopy, mass spectroscopy, and other separation techniques which make our group ideally suited for developing methods to determine or to detect the low levels of impurities in semiconductor grade gases and chemicals.

So how long has Air Products been doing this kind of work?

Actually Air Products has been analyzing for impurities in gases from the day it probably started. For the electronics customers, we have been doing this for over 20 years—ever since the establishment of the electronics division.

And specifically, can you describe some of the techniques that are currently used for the impurity analysis?

Currently we are using optical techniques like Cavity Ring Down Spectroscopy (CRDS) and Tunable Diode Laser Absorption Spectroscopy (TDLAS), as well as traditional mass spectroscopy techniques and gas chromatography techniques.

How about some examples of . . .any examples of where your work has made an impact?

If you go back about 10 years, you can see that Air Products played a vital role in making sure that the atmospheric pressure ionization mass spectrometry which was in its infancy at that time was applicable for a wide range of impurity analysis for semiconductor gases—much more than what was envisioned by people who first brought this technique to the industry. Another example is for the case of moisture in ammonia, moisture in ammonia is very critical for the gallium nitride fabricators and we worked with the instrument manufacturer to make sure that the infrared-based instrument was developed to meet these needs. As you are probably aware moisture and ammonia look very similar spectroscopically, so it is extremely difficult to detect low levels of moisture in ammonia. Another example is the work with small instrument manufacturers of CRDS laser-based and TDLAS laser-based instruments. We were able to use our expertise in handling gases and generating impurities that were very low levels with their expertise in manufacturing instruments to make sure that industry had instruments available which would analyze for impurities in gases at their desired level.

So what about the future for . . .see any trends for the future of trace impurity analysis?

As everybody is aware there's a lot of work going on in Homeland Security basically to develop sensors for detecting chemicals in the atmosphere or ambient air. I see in the near future some spill over from all the development work going on in that area into the semiconductor area where essentially the problem is similar. We have to detect very low levels of one chemical in another chemical. Once this happens, we'll see sensors which are very low cost available for the industry so they can put sensors everywhere within a fab and they'll have the validity to measure for these impurities at the point of use of the gases and chemicals rather than trying to measure it at a remote location and assume that nothing happens to the gases or chemicals in transporting them from the front of the fab to the actual processing tool.

Suhas, can you summarize for our listeners the key benefits of working with Air Products and the analytical area?

We have been analyzing for impurities in gases ever since the start of the company. We have a great depth in the personnel that are available and the techniques that are available to analyze for impurities. We have been working with instrument manufacturers in the past to make sure that the instruments that come out to the market can indeed meet the customer's needs. And we can integrate these instruments into our gas delivery systems to make sure that the customer not only gets the gases and chemicals that are meeting his specification, but the customer can also monitor to make sure that the gases are in compliance.

If some of our customers want to get additional information on this subject, how can they get that?

They can call me at (610) 481-2991 or send me a quick e-mail at ketkarsn@airproducts.com.

That sounds great. Once again for our listeners, you can contact Suhas Ketkar directly by his e-mail address which is ketkarsn@airproducts.com. Suhas, thank you very much for being with us today.

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Thank you for listening to this Air Products Podcast.