



Chamber Cleaning

Andy Johnson

Welcome to another Podcast from Air Products.

This is Ed McKendry and today's subject is Chamber Cleaning. Our guest today is Andy Johnson. Andy is a 13 year veteran with Air Products. He is a PhD chemist from MIT. In fact his PhD thesis was recognized with the Nobel Laureate Signature Award from the American Chemical Society. Andy's undergraduate work was done at the University of East Anglia and during his professional career most of his work has focused on the application development and support for specialty materials with the main focus on products like nitrogen trifluoride, hexafluoroethane, and silicon tetrafluoride. In 2002, Andy was part of an Air Products' employee team that was recognized by the United States government with the Climate Protection Award from the Environmental Protection Agency, better known as the EPA. Andy, thank you very much for being with us today.

Thanks, Ed.

As we said in the introduction there, today's subject is Chamber Cleaning and what do we mean when we're talking about chamber cleaning in semiconductor manufacturing?

What we're really talking about, Ed, is cleaning CVD or chambers used for Chemical Vapor Deposition. With this introduction today, what I really want to talk about is, although chamber cleaning does not directly involve wafer processing, it really is an important part of the semiconductor manufacturing operation.

Now, why do people do chamber cleaning? Why is that necessary?

It's necessary because with semiconductor manufacturing what we're really doing is sequentially depositing thin layers of materials. It could be a silicon-based material such as silicon dioxide or a metal such as tungsten. These materials or these thin films are deposited using Chemical Vapor Deposition or CVD. When we deposit these materials, not only do we deposit the thin films on the silicon substrate, but we're also coating the process chamber with a residue that needs to be removed. So when we talk about cleaning CVD chambers, we're talking about removing this residue after the deposition of the thin film.

So how do they go about—how do you actually clean a CVD chamber?

It's basically an etch process, Ed. It's an isotropic etch process. What we need to do is find a chemistry that can volatilize this residue that is on walls of the CVD chamber. We need to convert the residue into a gas that can then be pumped out of the chamber and that is the clean process. For silicon- and tungsten-based materials, all basically use a fluorine chemistry and we will use a fluorine plasma to generate fluorine atoms that will react with the silicon to form SiF_4 . In the case of tungsten, it will generate WF_6 . Both SiF_4 and WF_6 are volatile etch products that can easily be removed from the chamber.

What type of gases do you use to get this reaction?

You need a convenient source of fluorine. For most CVD chambers today, the gas that has been chosen is NF_3 or nitrogen trifluoride. For some of the older CVD equipment, a C_2F_6 or hexafluoroethane-based plasma will be used.

And I assume that there's pluses and minuses with each of those materials which for our listeners, we will be covering in detail the benefits of each of those different processes, both NF3 and C2F6, but again we'll be doing that in some future Podcasts. So Andy, back to our Chamber Cleaning 101, what are the opportunities that customers may have for reducing their cost or their emissions in this chamber cleaning process?

If you choose the right materials and optimize that process, you can identify conditions or processes that may reduce your costs, reduce your emissions, and also improve the wafer through-put. Each of these benefits is what we call optimizing the CVD chamber clean process and it really provides a win-win situation for a customer—faster cleans, reduced emissions, and reduced costs.

For our customers and people who may be listening out there. If they want additional information on this subject, how can they get that?

I'd be happy to talk with anybody further about this topic. Please send me a note. My e-mail address is johnsoad@airproducts.com and we also have a lot of information available at our website, I believe that is www.airproducts.com/electronics/chamber.

Once again for our listeners, for additional information please feel free to contact Andy Johnson directly at johnsoad@airproducts.com and Andy will be in touch with you directly. Also, we'd like to encourage you to continue to check back to our website where we will be adding additional Podcasts on some of the details of chamber cleaning as we mentioned in our program here.

Andy, thank you very much for being with us and thank you very much to the listeners.

Thank you for listening to this Air Products Podcast.