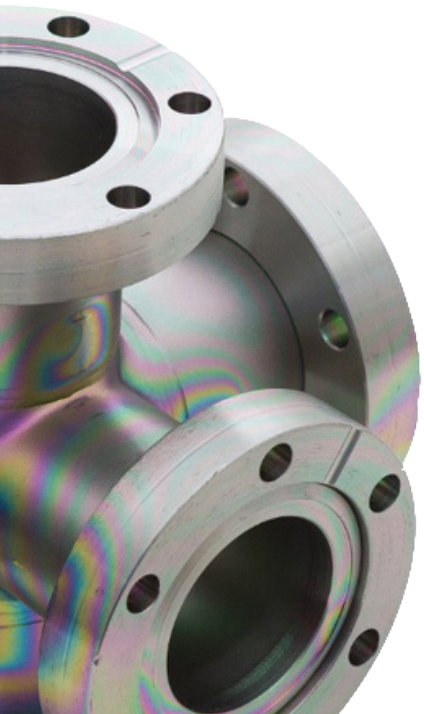
SilcoNert® 2000 on Aluminum for Measuring Ammonia

Technical Insight

Author

Jesse Bischof,
R&D Scientist

SilcoTek® Corporation



Synopsis

A group from Konkuk University in Korea looked to create an ammonia sensor that would be suitable for household use in combustion situations (home heating, automotive, industrial, etc.) Ammonia is known to be an active compound, particularly toward metal surfaces. SilcoNert 2000 is well known to not allow ammonia to stick to metal surfaces, but SilcoNert 2000 for aluminum has not yet been investigated. The group showed good results for the coating over an anodized aluminum part.

Background

Ammonia can be an issue for the health of plants, animals, and humans. Ammonia exposure can cause numerous conditions depending on concentrations including eye and skin irritation, burns, coughing, wheezing, shortness of breath and potentially death. The bulk of ammonia in the atmosphere is from agricultural activities such as fertilizer production and animal husbandry. A smaller, yet still significant amount (roughly 20%) of the emissions are from combustion processes across a wide variety of industries. Continuous monitoring of ammonia from these processes is important for regulatory purposes as well as general health.

There are a variety of ways to monitor ammonia, but a group from Konkuk University in Korea looked to develop a cold-type non-dispersive infrared analyzer. The details on that analyzer can be found in their paper published in Atmosphere.1 One hurdle for developing such an analyzer is the choice of materials to build the instrument. Ammonia can be quite reactive toward metals and many polymers. The group investigated the use of SilcoTek's new coating developed especially for aluminum: SilcoNert 2000 – SP12. This TI will focus on their investigation between an anodized aluminum gas chamber vs an aluminum chamber coated with SilcoNert 2000 – SP12.

Data and Discussion

The research group was investigating ammonia in trace levels and noticed that unlike the other gases in their study, the anodized aluminum chamber would adsorb small amounts of the ammonia causing issues with response time. The researchers discussed various options such as Teflon coating, but noted that it is very difficult to apply Teflon coating to long narrow spaces, such as the chamber for their analyzer seen in Figure 1. They also discussed switching to a different alloy such as stainless steel, but steel experiences the same adsorption issue. They then turned to SilcoNert 2000 which has been shown to not allow ammonia adsorption to its surface.

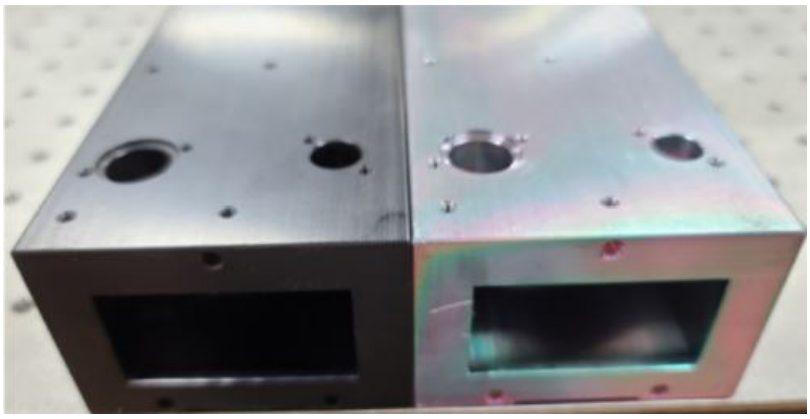


Figure 1: Two different chambers for the cold-type non-dispersive infrared analyzer. Left is the anodized aluminum chamber and the right shows the SilcoNert 2000 – SP12 coated chamber.

Aluminum has many advantages over steel in this application such as ease of machinability and its comparatively light weight. SilcoTek has previously discussed issues with applying SilcoNert 2000 to aluminum substrates and the steps that have been taken to develop a new coating that successfully coats aluminum. That TI can be read here. Figure 2 shows the comparison between the anodized chamber and the SilcoNert 2000 – SP12 chamber.

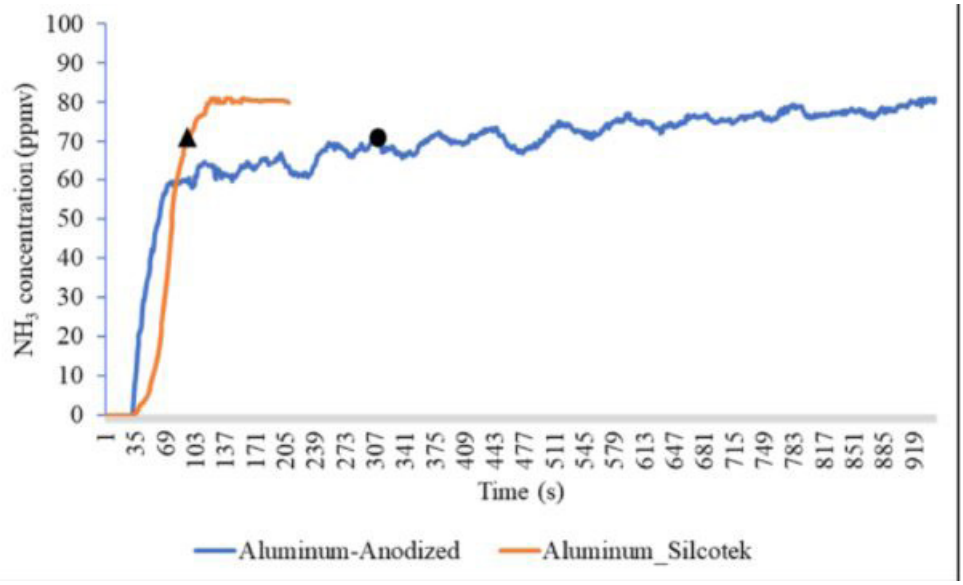


Figure 2: Comparison of the anodized (blue) and SilcoNert 2000 – SP12 coated (orange) analyzer response to 80 ppm of ammonia. The black triangle and black circle indicate when the detectors have reached 72 ppm, which is 90% of the ammonia that was injected into the system.

The SilcoNert 2000 – SP12 coated chamber reached the 90% level (72 ppm) in an average of 66 seconds. The graph in Figure 2 is representative of just one of the three runs that were tested. Alternatively, the anodized aluminum chamber reached the 90% level in an average of 397 seconds across three runs. The authors noted that SilcoNert 2000 – SP12 chamber was consistent in the three runs both before and after the 90% mark. It quickly reached the full 80 ppm mark and maintained the stability through the time of the measurement. The anodized aluminum chamber experienced “high variability” before and after the 90% mark and took dramatically more time to reach the full 80 ppm level indicating the ammonia was lost due to high adsorption in the chamber.

Conclusion

Researchers looking to develop an ammonia detection system investigated the use of anodized aluminum and SilcoNert 2000 – SP12 coated aluminum. They found that while an anodized aluminum chamber had inconsistent results, a chamber coated by SilcoTek yielded fast and consistent results. The group investigated numerous other conditions to optimize the detector, but when it comes to material compatibility, SilcoNert 2000 - SP12 was the clear winner.

Reference

Dinh, T.-V.; Choi, I.-Y.; Park, B.-G.; Lee, J.-H.; Kim, I.-Y.; Gil, H.-N.; Lee, S.-W.; Kim, J.-C. Development of a Negligible Zero-Drift NDIR Analyzer for Measuring NH3 Emitted from an Urban Household Solid Waste Incinerator. Atmosphere 2021, 12, 858. https://doi.org/10.3390/atmos12070858

