SilcoNert Coating vs. Electropolish

Solve Supply Chain Challenges with Better Surface Technology

Electropolishing (EP) is an electrochemical technique used to improve metal surfaces. Metal parts are placed into a fluidic bath that an electrical current is then passed through. This creates a smooth and passive surface that is more desirable that stainless steel in applications like semiconductors, medical devices, analytical chemistry, pharmaceuticals, and more.

Engineers in these industries require special surface modifications to improve the compatibility and performance of preferred materials of construction like stainless steel. Electropolishing has historically been considered a solution by default. However, today, EP often carries extreme lead times which lead to higher costs in the form of expedite fees, lost production yield, and customer disappointments. Additionally, although improved over unpolished metal, EP still leaves exposed metal throughout the flow path which leads to catalytic activity, adsorption, and subsequent problems in chromatography, pharmaceutical manufacturing, semiconductor gas delivery, and many other sensitive applications.

SilcoNert® CVD coatings on stainless steel provide superior chemical inertness, corrosion resistance, and surface properties than electropolishing. SilcoTek® coats high volumes of parts within a few weeks for any customer, large or small. We partner with leading manufacturers across the globe to stock SilcoNert-coated tubing, valves, fittings, and more.

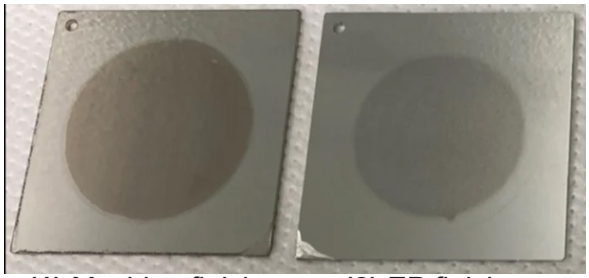
Can SilcoTek CVD Coatings Replace Electropolishing?

Even better, the data below prove that SilcoNert can replace electropolishing and outperform it. SilcoTek's gas phase coating process uniformly deposits a thin layer of inert amorphous silicon across 100% of any part surface, even complex and torturous geometries such as micron-sized filters. The SilcoNert coating process is a universally acknowledged surface solution for creating a chemically protective metal-free barrier to improve inertness, reduce the effects of corrosion and ion leaching, and increase hydrophobicity. These coatings are written into material specifications for the world's largest public and private organizations to enable accurate detection of trace impurities, extend the lifetime of critical components, and improve the purity of metal surfaces.

Corrosion

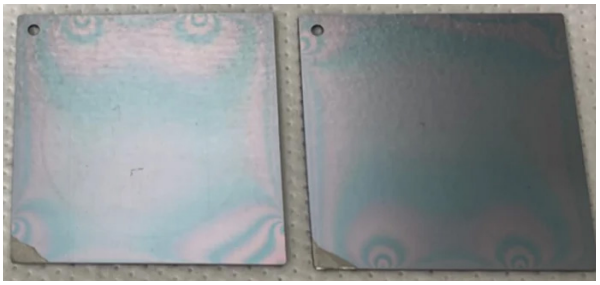
The coating provides excellent corrosion resistance, protecting the underlying material from degradation caused by harsh chemicals, moisture, or corrosive gases. This extends the lifespan of the components and ensures the integrity of the transfer system over time. SilcoNert 2000 provides a good corrosion barrier for 5% HCl, as shown in the chart below each coupon type. The SilcoNert coated coupons show over **100x** better corrosion protection than the EP coupons.

Surface (Images on right)	(1)	(2)	(3)	(4)
Corrosion Current (µA)	726.8	180.9	4.9	5.9
Corrosion Rate (mpy)	22.745	5.661	0.153	0.186
Improvement Factor	n/a	4x	149x	122x



(1) Machine finish no coating

(2) EP finish no coating



(3) Machine finish SIlcoNert2000

(4) EP finish SilcoNert2000

Inertness

SilcoNert 2000 creates an inert surface, reducing the chances of chemical reactions or adsorption, making it ideal for handling sensitive materials or samples without contamination or reaction. For this experiment, electropolished tubing (Fig. 5) and SilcoNert 2000 non-electropolished coated tubing (Fig. 6) was filled with 100 psi nitrogen that contained 20 ppb hydrogen sulfide (H_2S), carbonyl sulfide (COS), and methyl mercaptan (MeSH). It was monitored through days 0, day 1, and day 4, as shown in the chromatograms below.

The electropolished tubing in Figure 5 shows an immediate loss of signal for all reactive materials with the yellow box area of interest showing a complete loss of MeSH signal on Day 1. When compared to SilcoNert 2000 non-electropolished coated tubing in Figure 6, all reactive materials still maintain a nearly identical signal from Day 0 to Day 4. These results highlight the impressive inertness needed for the accurate detection of trace impurities over time.

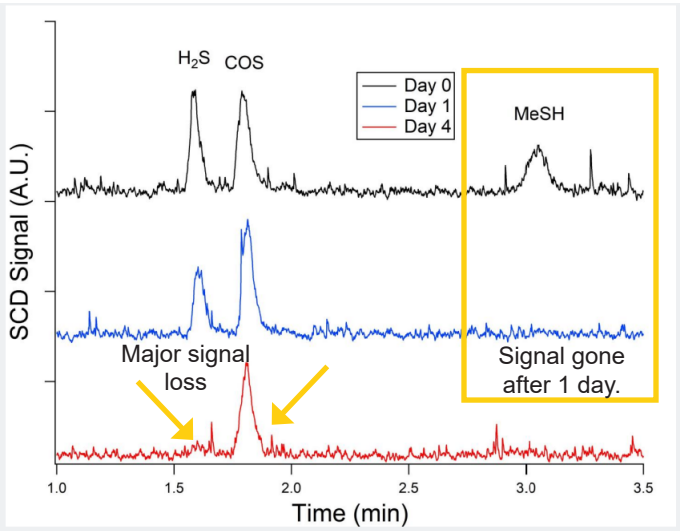


Figure 5. Electropolished tubing

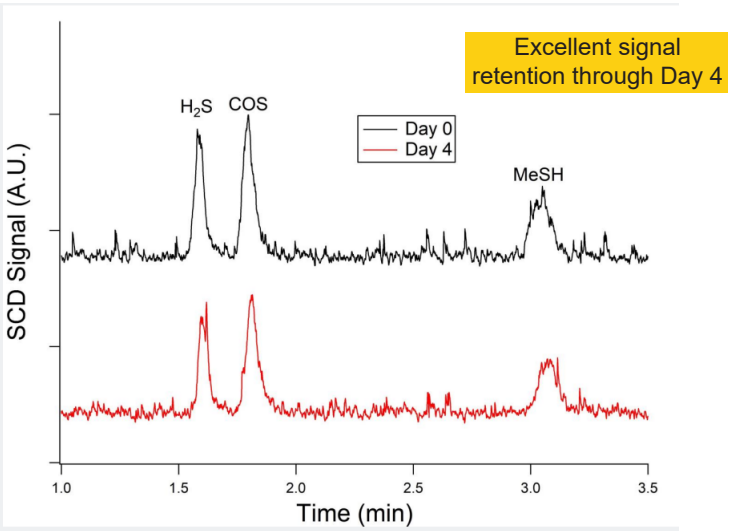


Figure 6. SilcoNert coated, non-electropolished tubing

Improve Hydrophobicity, Boost Dry Down Performance

The SilcoNert coating technology lowers the surface energy of materials, improving the hydrophobicity and reducing the adhesion ability of liquid molecules to the surface. This allows for a faster dry down time which is necessary in analytical instruments or applications where maintaining sample purity and minimizing carryover is crucial.

Figure 8 (is Figure 7, 5x zoom) shows electropolished surfaces have a nearly immeasurable impact over non-electropolished surfaces when quantifying moisture content over time. The SilcoNert 2000 non-electropolished coated surface cuts dry down time in half, saving over 15 minutes in comparison to electropolished surfaces and 25 minutes to untreated surfaces. The improved hydrophobic SilcoNert technology will allow users to save time while maintaining a high standard of purity.

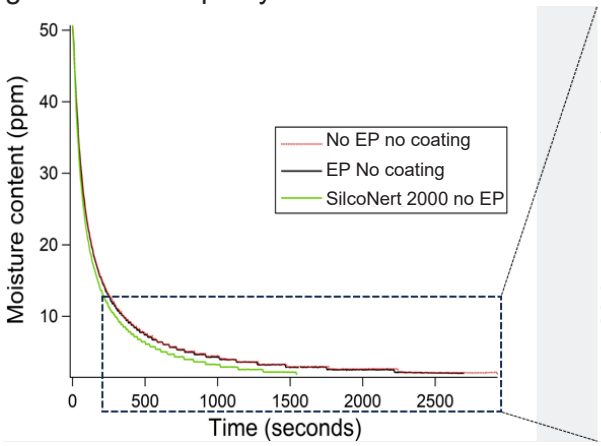


Figure 7

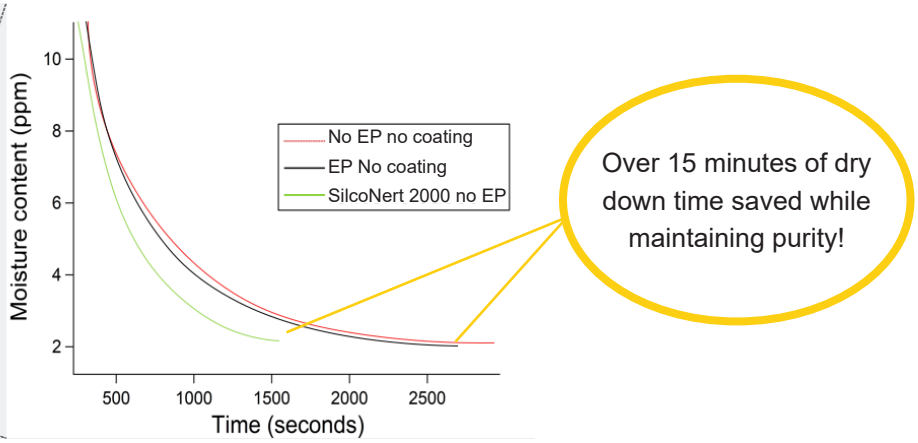


Figure 8