Technical Insight

Title: Coating of Frits: How about Dursan?
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Background:

A previous TI, which can be viewed here, discussed the coating of a 2 µm sintered stainless steel frit with SilcoNert 2000. Briefly, we saw that it conformally coats all of the internal networks of the frit, and the coating thickness ranges from 50 nm to 80 nm. SilcoNert 2000 is not the only coating that we apply to fritted materials. Dursan has increased in popularity as a coating for fritted materials due to its anti-coking properties in coal gasification systems as well as its general inertness and corrosion resistance in analytical equipment. As Dursan and SilcoNert use very different precursor gases, the question was raised: will Dursan coat the internals of a fritted material as well? This TI will address that question.

Discussion / Data / Links:

A 2 µm stainless steel frit was coated with Dursan using our SOP recipe. The frit was then broken in half to expose the internal network of the frit. Figure 1 shows an electron micrograph of the inner workings of the sintered frit. As discussed in TI 08-13-18, this network would not be trivial to coat via traditional methods such as PVD, paints, or epoxies as they are line of sight techniques. Our CVD technique is non-line of sight and can penetrate the tortuous network of a sintered frit.

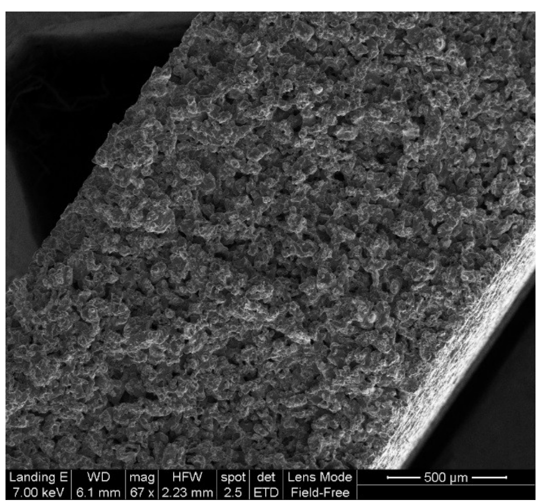

Figure 1: Electron micrograph of the sintered frit after it had been coated and broken in half to expose the internals of the part for analysis.

The common concern for most customers is whether the entirety of the part receives the coating, as any uncoated location would be a potential failure spot in their part. Figure 2 shows an EDS map of the iron, silicon, and oxygen signal in the same location as Figure 1. The silicon and oxygen are the two most abundant elements in the Dursan coating, and the iron signal is from the stainless steel substrate that is being coated. The maps show good penetration through the entirety of the frit. While there are areas in the silicon and oxygen map that are showing no signal, note that these black areas are also in the iron signal which means they are shadowing effects from the rough surface rather than holes in the coating.

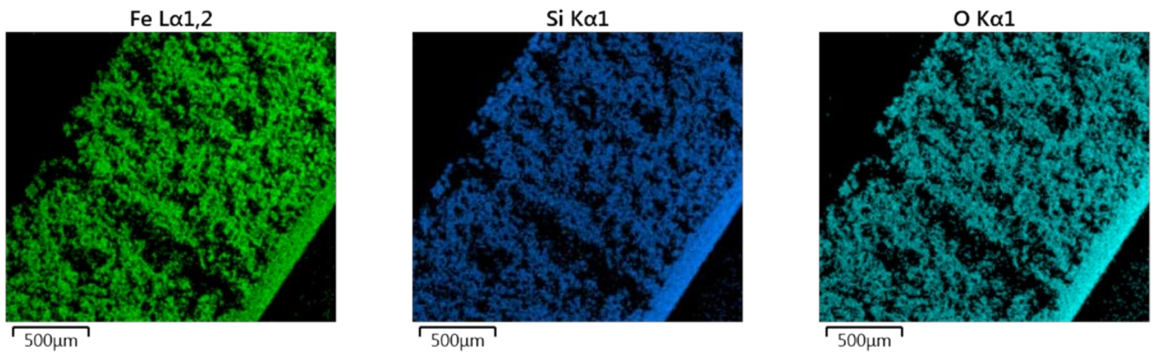

Figure 2: EDS map of the stainless steel frit. The silicon and oxygen signals penetrate entirely through the fritted material showing good coating exists throughout the frit.

Figure 3 and 4 are an electron micrograph and EDS maps similar to Figure 1 and 2, but at a higher magnification in the center of the frit. This higher magnification shows that the coating conforms to the internal network of the frit. In addition to the SEM/EDS work to show full coverage, a measurement was taken of the coating thickness, and the results were very similar to the SilcoNert 2000 coated frit (50-80 nm). It ranged from 60 nm in the very center of the frit to 80 nm toward the outer surface. This consistency is due to the surface area to volume ratio consistency within the internal working of the frit.

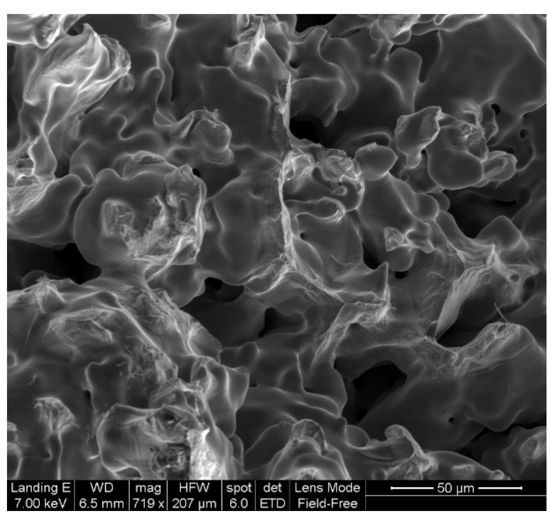

Figure 3: Electron micrograph of the internal network of a 2 µm sintered frit at higher magnification.

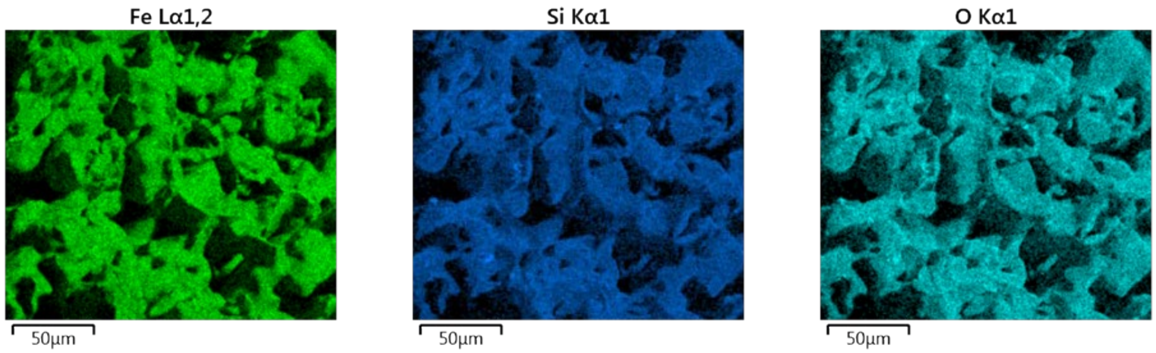

Figure 4: EDS maps of iron, silicon, and oxygen at a higher magnification within the sintered frit.

Conclusion:

The two most common coatings for fritted materials at SilcoTek are SilcoNert 2000 and Dursan. SilcoNert 2000 was previously shown to coat the entirety of a 2 µm sintered stainless steel frit. Here, Dursan showed the same ability to penetrate all of the pores of a frit and conformally coat the tortuous network. The coating is 60-80 nm thick through the frit which will have a minimum impact to the pressure needed to flow through the frit.