But I'm Wearing Finger Cots!
Don't let Handling Materials be your demise
Foresite Inc.

Every once in a while, it is good to examine assumptions you (or your management) have made in your manufacturing process. This case study involved handling residues. The high volume assembler was a manufacturer of automotive sensors. The sensor in question was a ceramic-based (alumina) exhaust gas sensor. As part of the sensor development, the sensor was soldered with a no clean process, parylene coated and exposed to several hundred hours of hot exhaust gases under operating bias. When the sensors would fail, it would be due to corrosion. The coating had cracked and come off in a number of cases. The underlying circuitry was severely corroded. What was the fault: the flux, the coating, or the processing? Through a long series of analyses, in which we eliminated various effects, we determined that handling residues were the root cause of the problem. The assembler was aware of the harmful effects of handling resides on circuits, and so used pink-poly finger cots whenever the ceramic parts were handled. The assumption was that the finger cots would protect the alumina base from finger salts and oils.

Chart 1

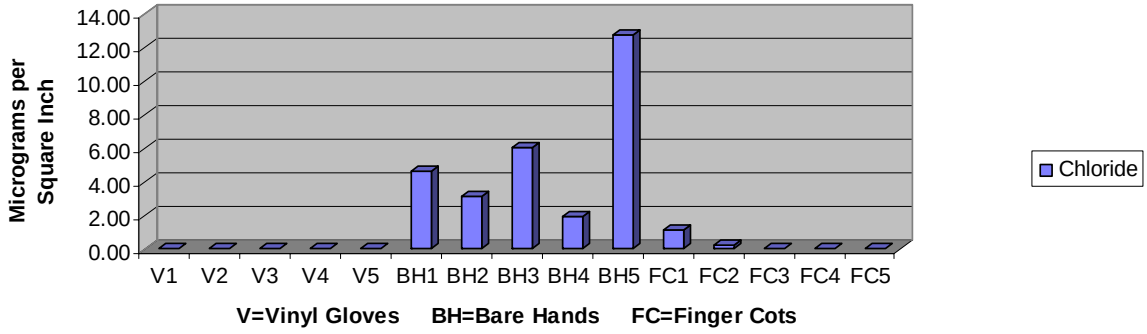

Chart 1 shows the results of a handling experiment. Virgin ceramic parts were pre-cleaned to a zero residue level. As a basis for comparison to the finger cots, parts were handled with bare hands (worst case) and with hands covered with the non-contaminating gloves we use in our lab (best case). All residues were characterized using **ion chromatography**. Sample 1 of each set was an alumina part handled for one minute with fresh vinyl gloves (V), bare hands (BH) or finger cots (FC). Sample 2 of each set was another virgin sample, handled for one minute without changing hands/gloves/cots. Successive virgin samples were likewise handled for samples 3-5. Sample 5 was, therefore, the fifth virgin part handled with the same hands/gloves/cots.

The bare hands and the vinyl gloves yielded expected results. Bare hands contain high levels of chloride from finger salts. The result for the finger cots showed that when first put on, an unacceptable amount of chloride was transferred to the substrate. The assembler was doing the expected good job and changed to fresh finger cots at regular intervals unfortunately providing fresh chloride at each change.

**Foresite recommends chloride levels on ceramic substrates of no greater than 0.6 mg/in^2. Values higher than this often result in corrosion and metal migration.*

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The conclusion was that chloride from the cots was baked onto the substrate during the reflow operations that followed most of the handling. It was a no-clean operation, so the residues remained. The parylene coating had an isopropanol/water wash prior to coating, but it was ineffective against the problem residues. The chloride reacted with water in the humid environment during the exhaust gas testing. A build up of corrosion was the result. This stressed the parylene and causing small cracks in the coating. The cracks allowed ingress for the highly corrosive exhaust gases, precipitating the catastrophic failures.

When the assembler changed to a non-contaminating hand protection, the problems went away. With a clean base, no ionic material was available to cause corrosion under the coating; no underlying stress was placed on the coating and the parylene retained integrity throughout the test. To the engineers' delight, the sensors then tested well beyond the design life of the unit.

So, what kinds of handling materials are you using?!