

Identification and evaluation of contamination sources during clean room preparation of SRF cavities

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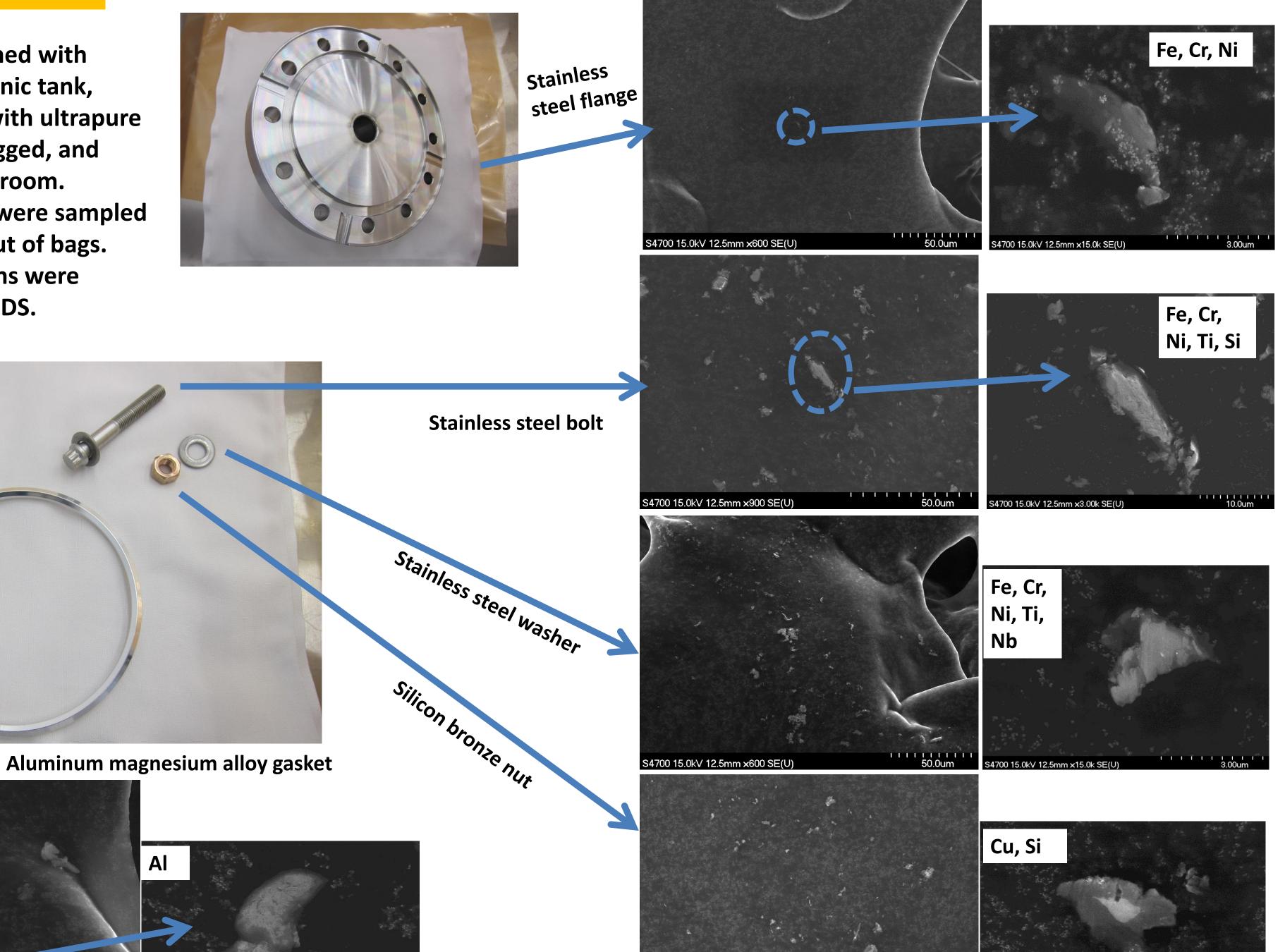


### **Abstract**

Particles are one possible cause of field emission issues in SRF cavity operations. During clean room cavity preparation, several processes could contribute to the generation of particles. One of them is friction between hardware during assembly. It is important to understand the behaviors that generate and propagate particles into cavities. Using a single cell cavity, particle shedding between flanges and other materials have been tested. The number of particles is recorded with an airborne particle counter, and the generated particles with examined are microscopes. The migration of particles different into movements is studied. Suggestions are made to reduce particle generation and prevent contamination of the cavity interior area.

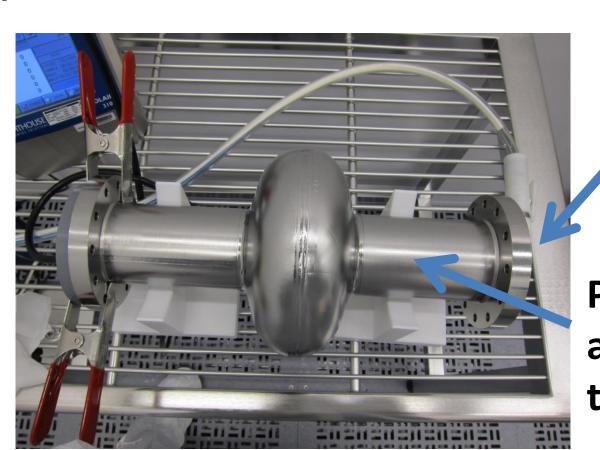
#### **Assembly hardware**

- Hardware was cleaned with detergent in ultrasonic tank, thoroughly rinsed with ultrapure water, air-dried, bagged, and transferred to cleanroom.
- Hardware surfaces were sampled for particles right out of bags.
- Particle compositions were identified by SEM/EDS.



### Horizontal assembly - disassembly

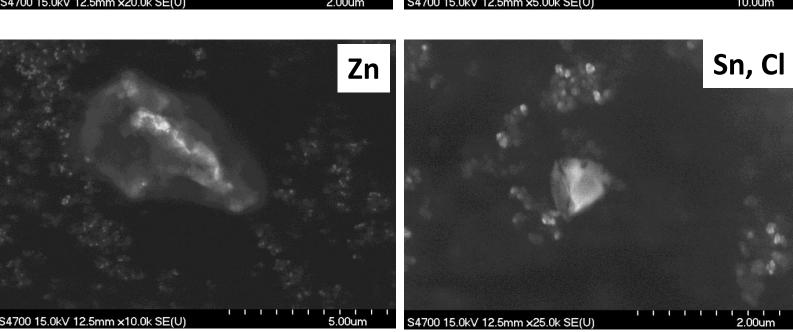
1.3 GHz, Tesla shape, large grain niobium, single cell cavity, ultrasonic cleaned, high pressure rinsed, air dried in cleanroom.



0.3 μm particle counts during Assemble horizontal assembly-disassembly flange

**Particle counter** 400 Assemble Disassemble and carbon **\$** 300 250 200 tape inside 150 100

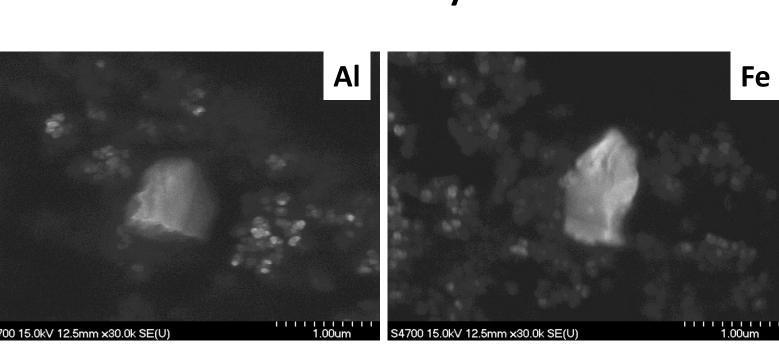
- Sn, In, Ga
- Si, Mg Fe, Cr, Ni



**SEM** images of particles found near particle counter entrance during horizontal assembly-disassembly. Particle counter entrance was located inside the middle of beam pipe.

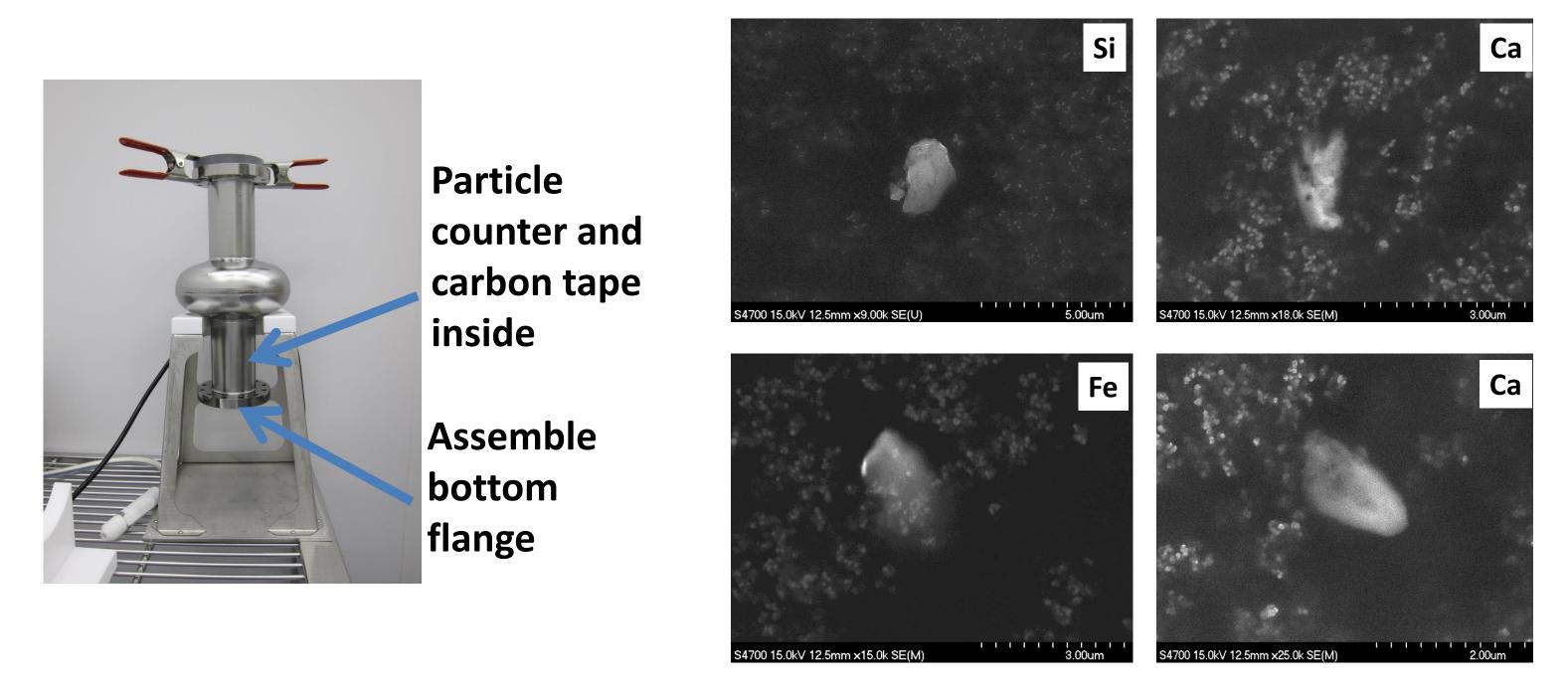
By trainee

Some particles showed composition that matched the assembly hardware, while others did not. The particles with foreign composition may be carried from other surfaces in the assembly area.

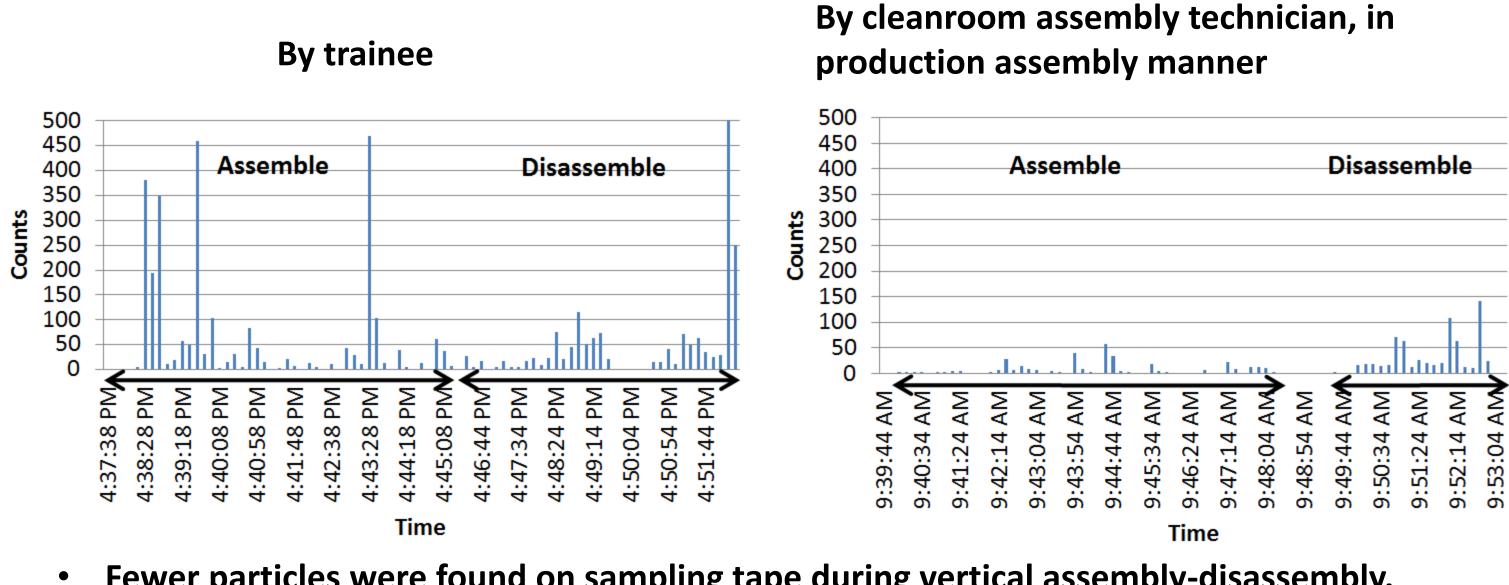


**During wiping** 

## Vertical assembly - disassembly



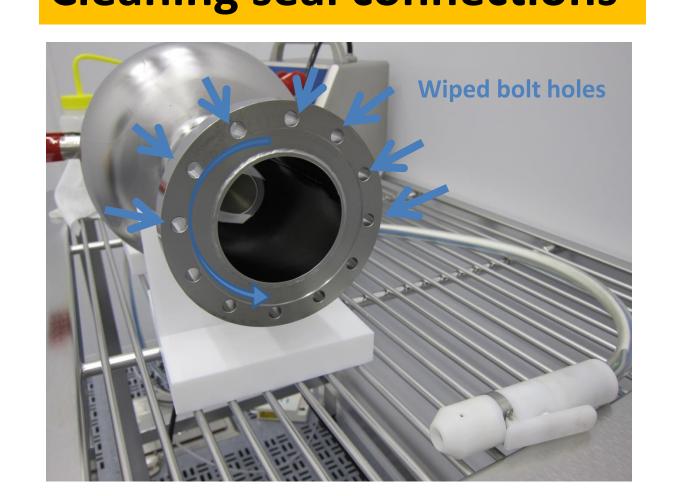
## 0.3 µm particle counts during vertical assembly-disassembly



- Fewer particles were found on sampling tape during vertical assembly-disassembly.
- Particles were found at locations near the particle counter entrance.
- No particles were found at locations on the cavity inner wall.
- Some particles showed composition that matched the assembly hardware, while others did not. The particles with foreign composition may be carried from other surfaces in the assembly area.
- Assembly-disassembly done by cleanroom assembly technician in production manner had much lower particle counts than trainee assembly-disassembly.

**After wiping** 

## Cleaning seal connections



- During wiping, particle counter was placed inside beam tube, same as the assembly-disassembly setup;
- After wiping, cleanliness of bolt holes were checked by blowing with nitrogen gun with particle counter monitoring near each individual bolt hole;
- Wiping significantly reduced particle counts of bolt holes.

# 5000 4000 3000 2000 1000

0.3 µm particle counts during and after cleaning bolt holes and seal surface with alcohol soaked clean room wipe **Unwiped bolt holes** 5000 3000 2000 1000 Wiped bolt holes

#### Summary

- ☐ Particle counter inside cavity during assembly is a useful method for comparing assembly skills, but is only partially representative of real cavity assembly process;
- In the experiment, particles come from both assembly hardware and clean room environment;
- Wiping bolt holes with alcohol significantly reduces particle counts, and should be applied after disassembly when ultrasonic cleaning is not available.

## Acknowledgement

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