6 GHz cavities coating status

CERN-INFN-STFC Agreement N. KE2722/BE/FCC

Regular video meeting, 1st of February 2019

6 GHz cavities coating status

- Very promising results → 4 Nb on Cu flat Q cavities coated

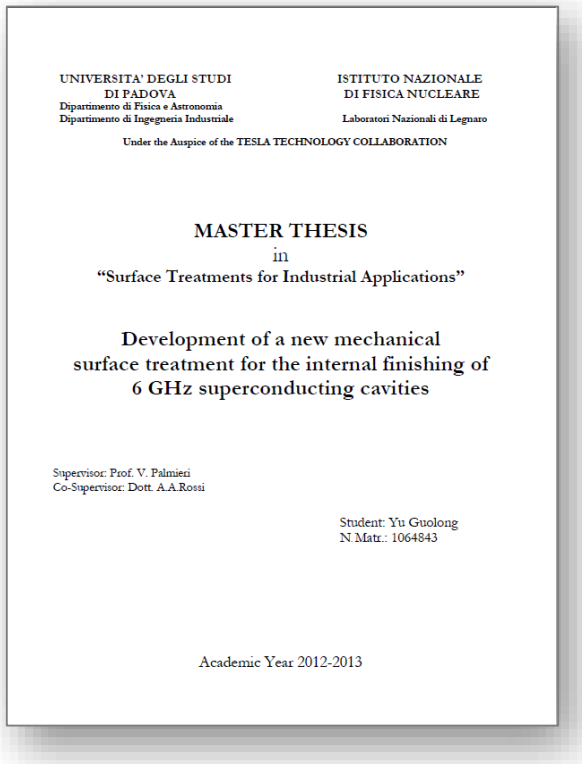
6 GHz cavities coating status

- Very promising results → 4 Nb on Cu flat Q cavities coated

- Reproducibility issue → Improvement of the surface quality is mandatory

Vibro tumbling

- Same concept of CBP, but vibration instead of rotation
- Already explored at LNL in 2013
  - High Removing Rate (around 6 μm/h)



UNIVERSITA' DEGLI STUDI DI PADOVA
Dipartimento di Fisica e Astronomia
Dipartimento di Ingegneria Industriale

ISTITUTO NAZIONALE DI FISICA NUCLEARE
Laboratori Nazionali di Legnaro

Under the Auspice of the TESLA TECHNOLOGY COLLABORATION

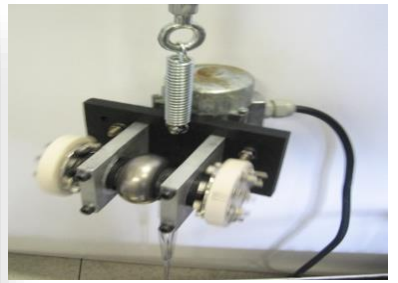
MASTER THESIS
in
"Surface Treatments for Industrial Applications"

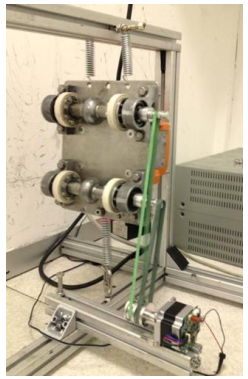
Development of a new mechanical surface treatment for the internal finishing of 6 GHz superconducting cavities

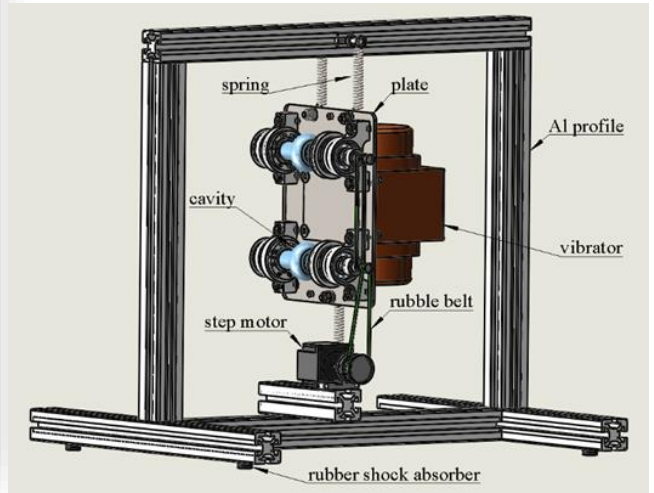
Supervisor: Prof. V. Palmieri
Co-Supervisor: Dott. A.A.Rossi

Student: Yu Guolong
N.Matr.: 1064843

Academic Year 2012-2013





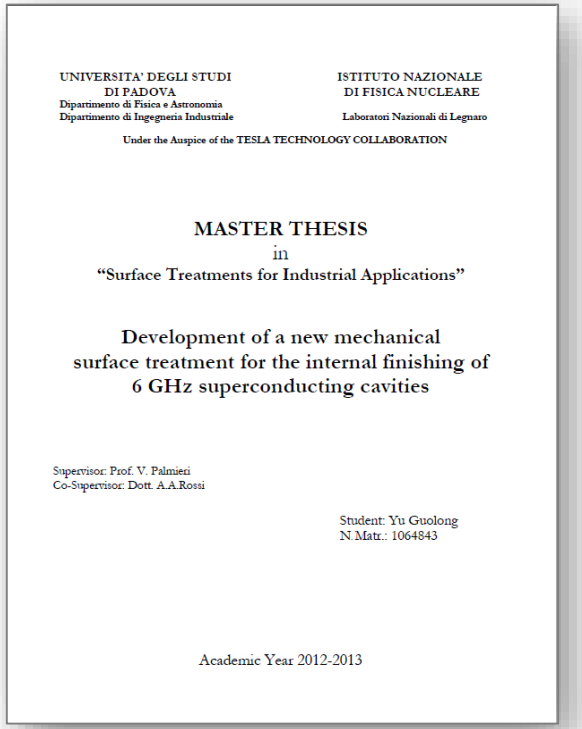


Vibro tumbling

- Same concept of CBP, but vibration instead of rotation

- Already explored at LNL in 2013
  - High Removing Rate (around 6 µm/h)
  - Unstable system
  - Low reproducibility

  - Abbandoned technology



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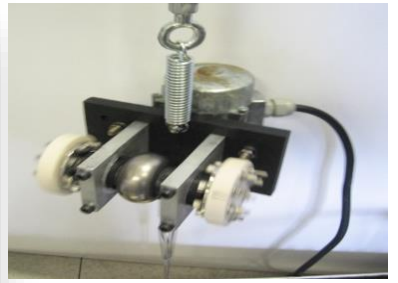
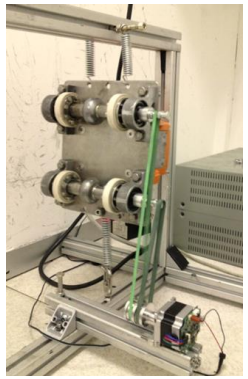
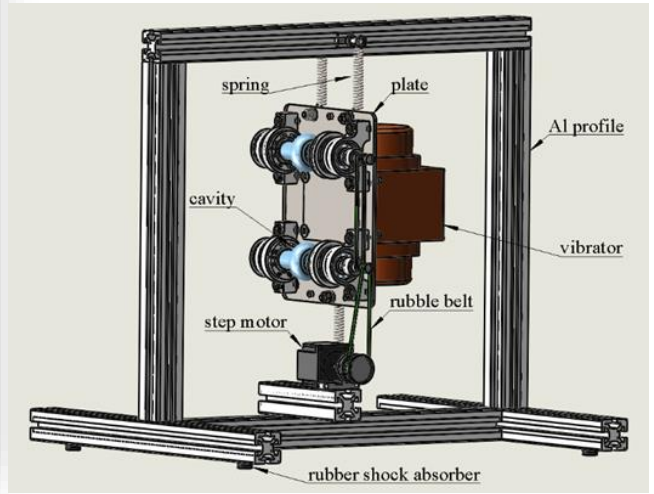
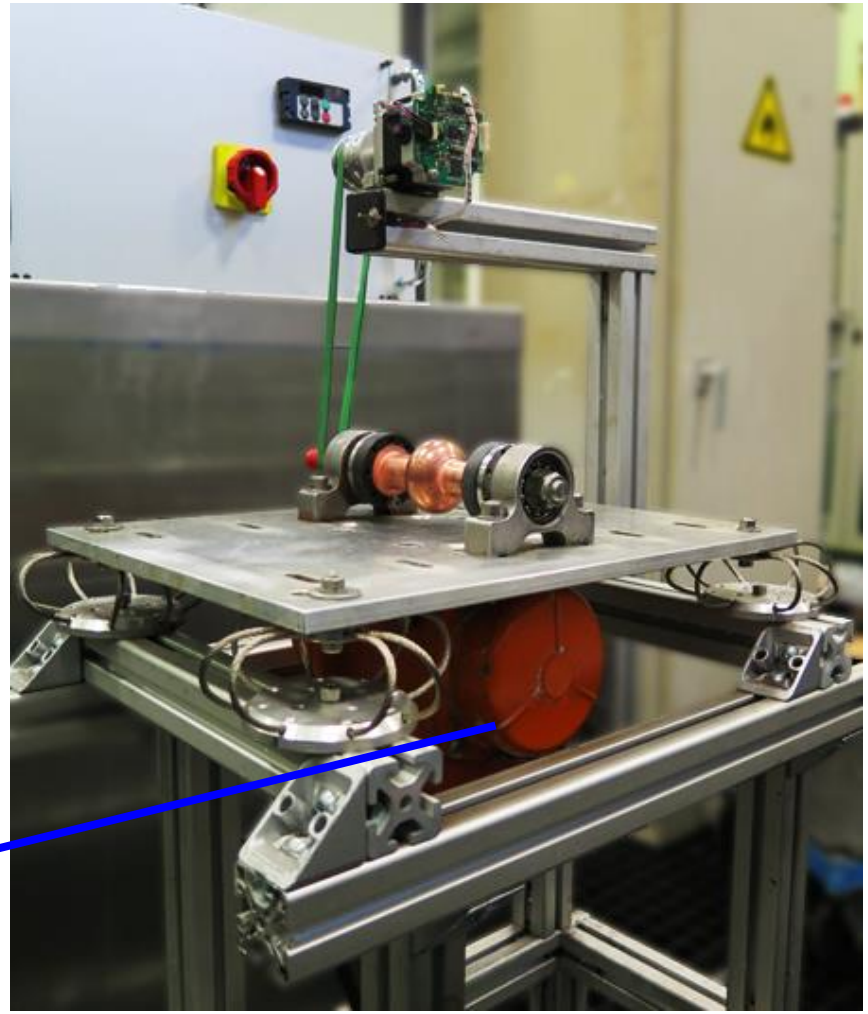






New LNL 6 GHz vibro tumbling



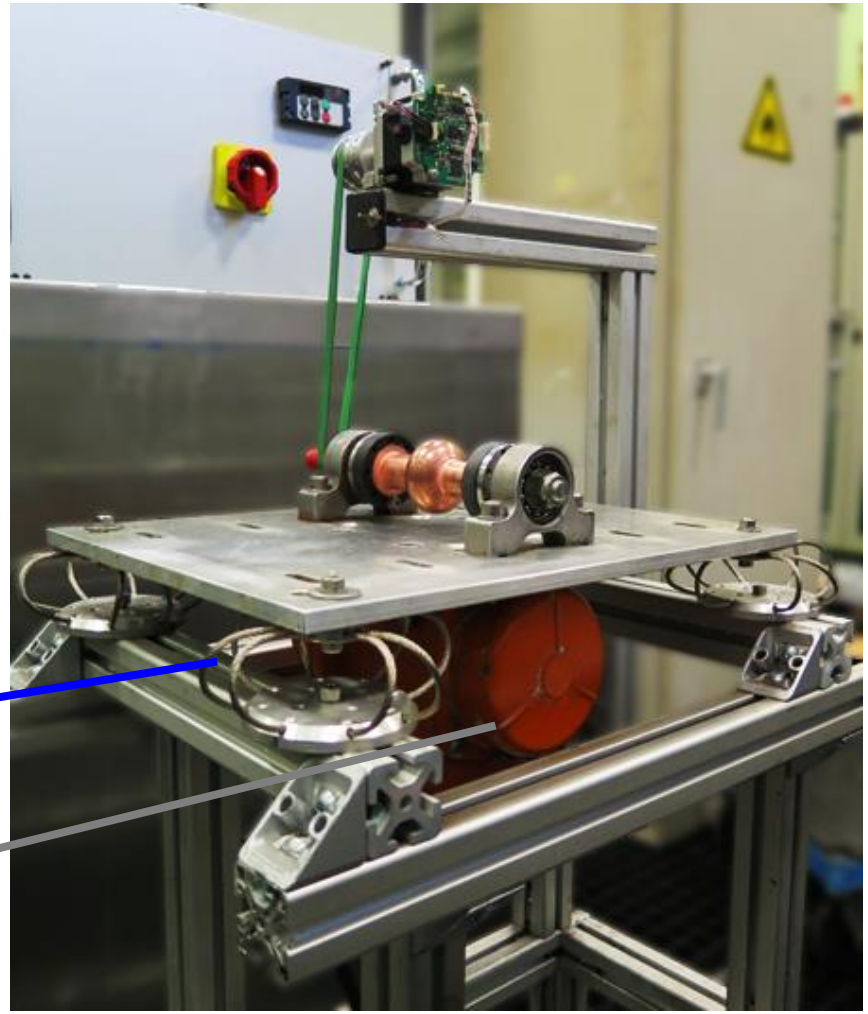
Eccentric motor (vibration)

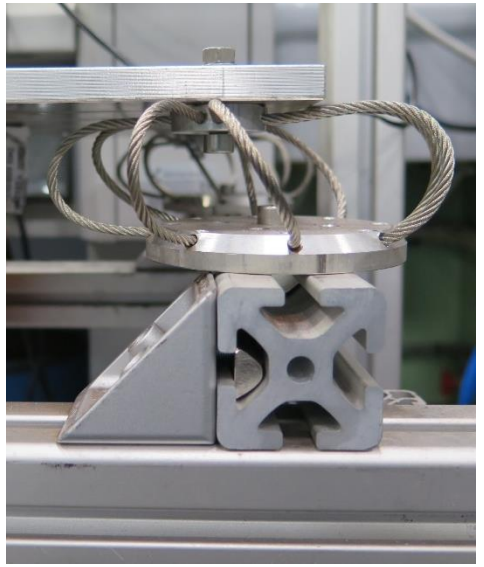
Unbalanced mass motor

New LNL 6 GHz vibro tumbling

Steel wire rope shock absorber

Eccentric motor (vibration)



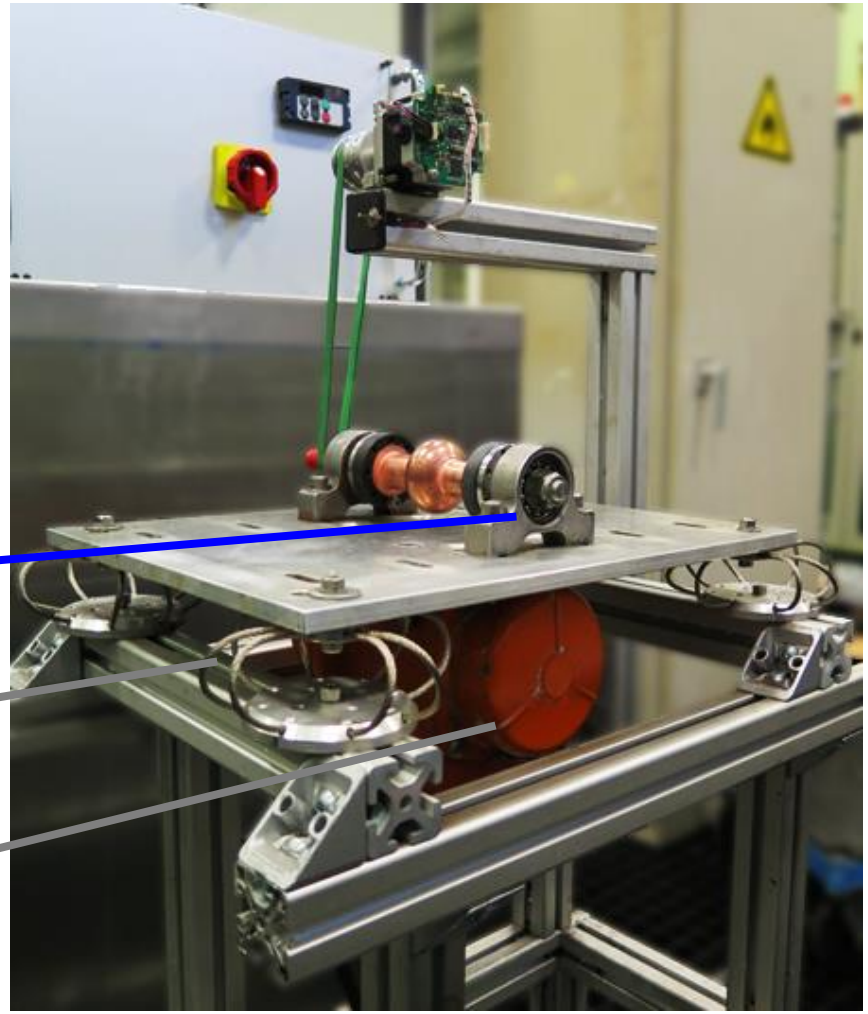


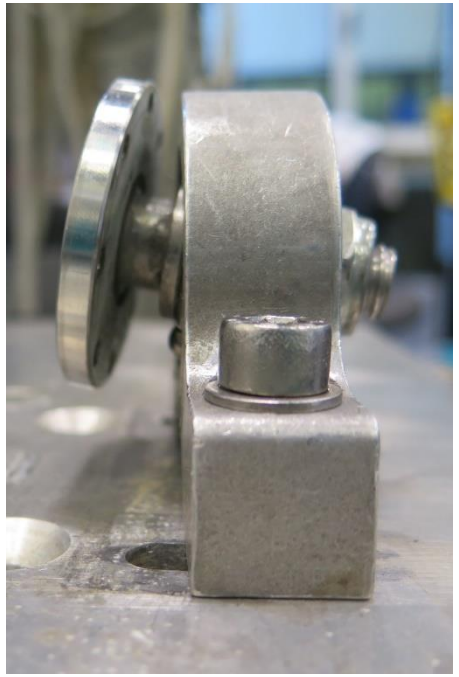
New LNL 6 GHz vibro tumbling

Self aligning bearing

Steel wire rope shock absorber

Eccentric motor (vibration)





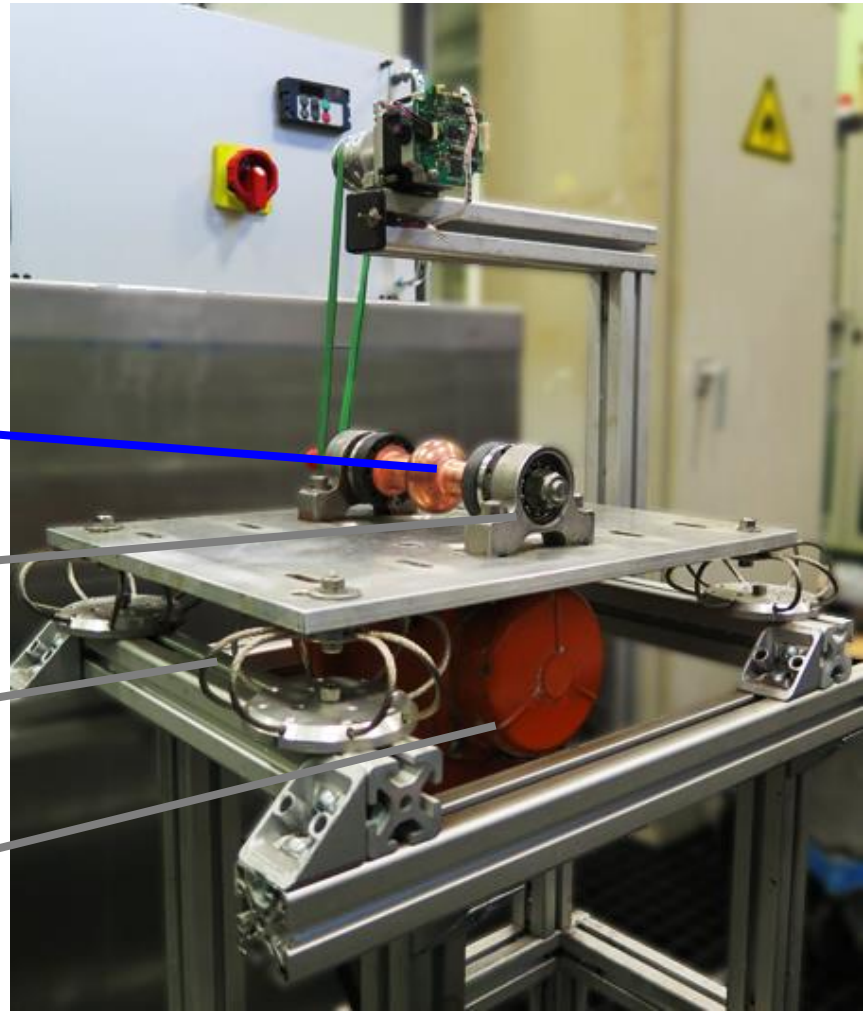
New LNL 6 GHz vibro tumbling

6 GHz cavity

Self aligning bearing

Steel wire rope shock absorber

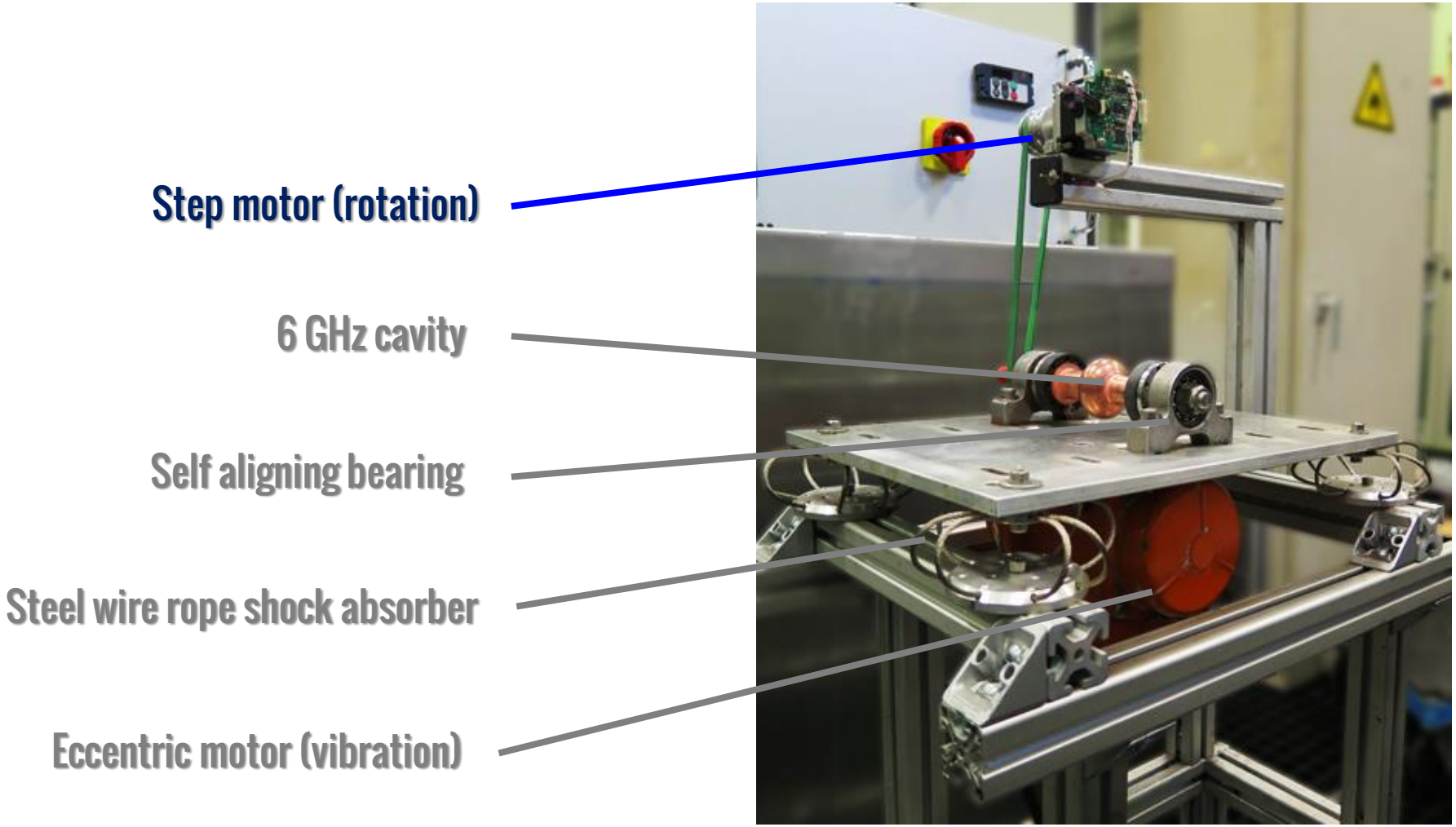
Eccentric motor (vibration)



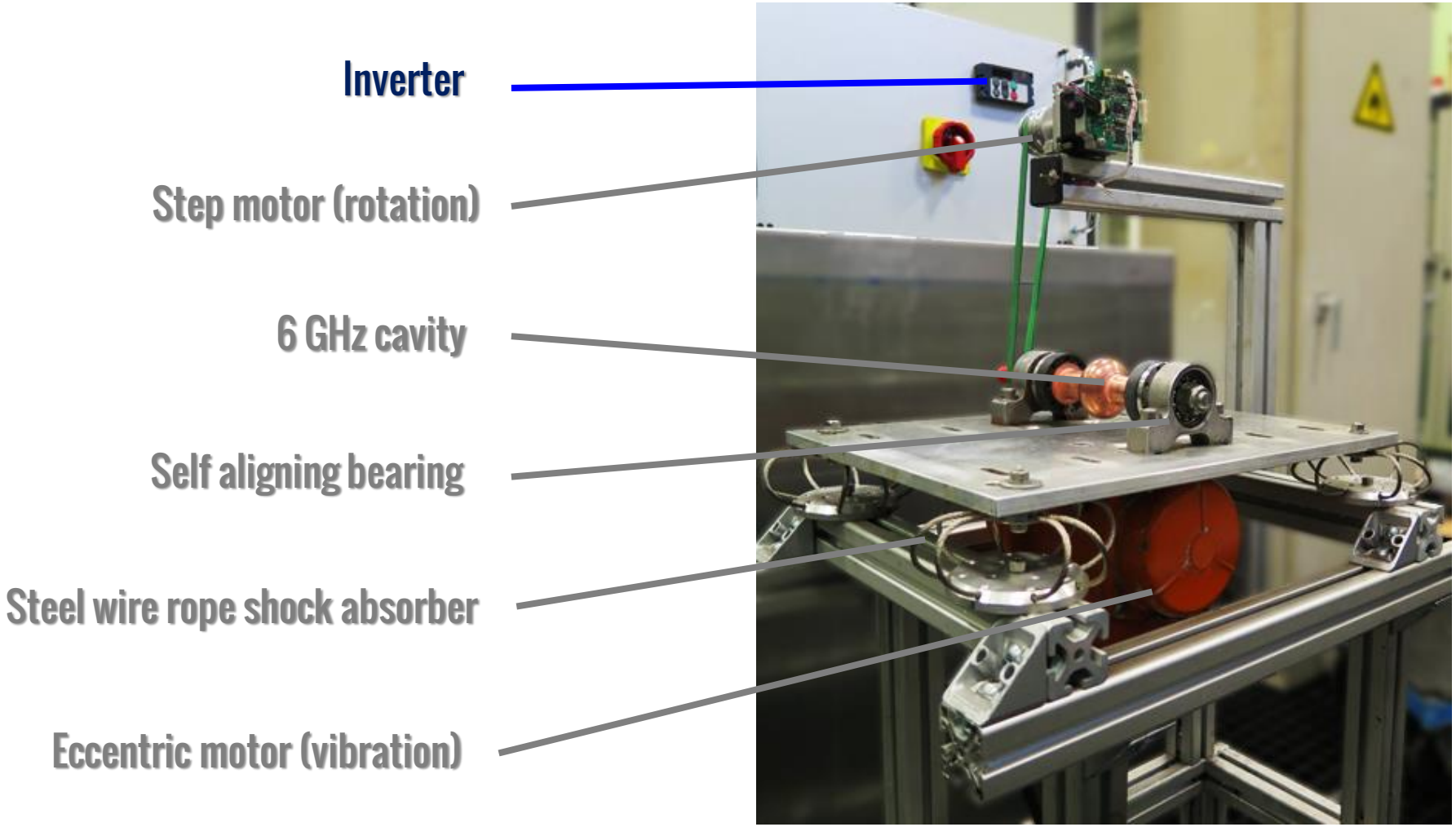
Test cavity

Coupons

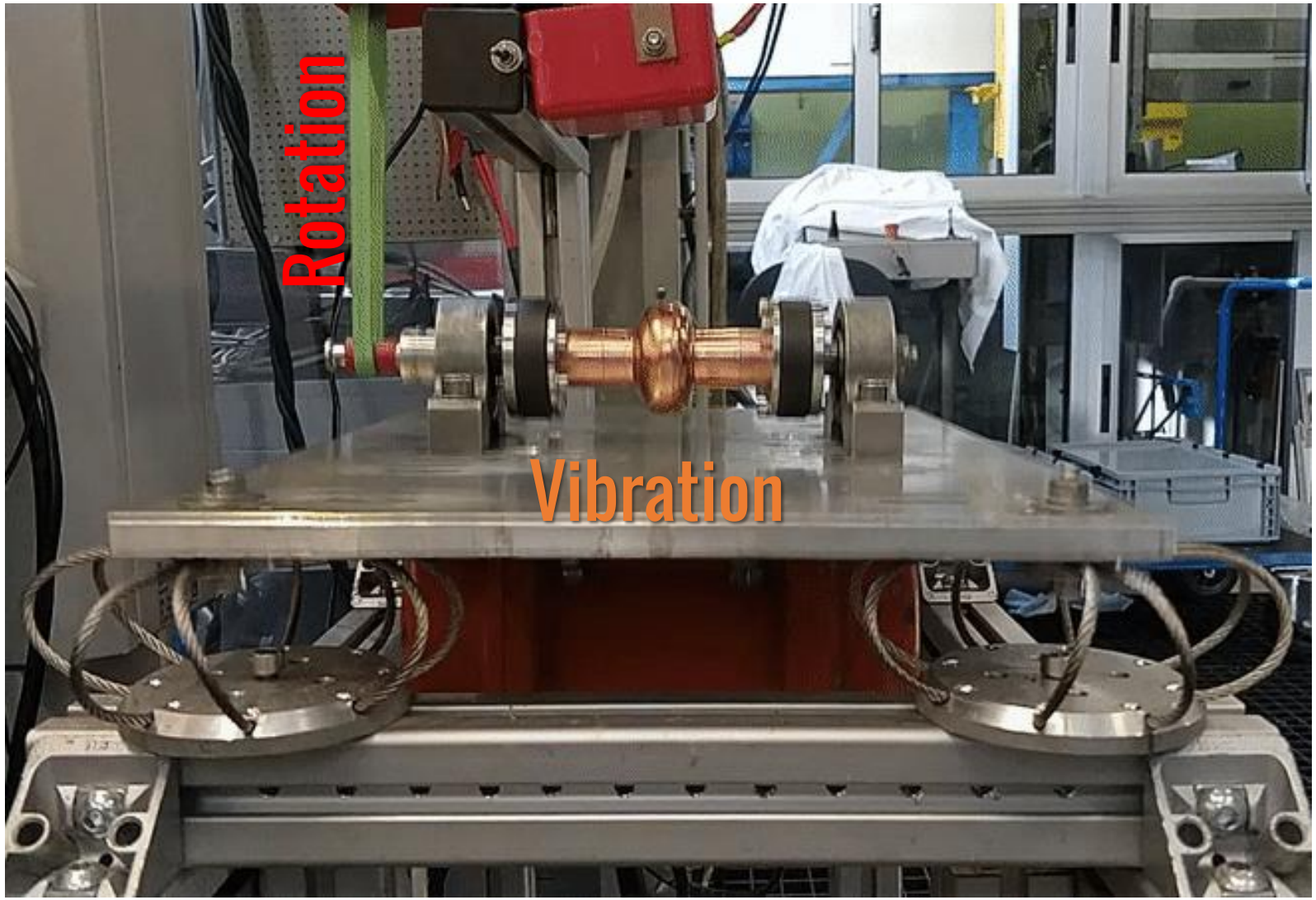
New LNL 6 GHz vibro tumbling



New LNL 6 GHz vibro tumbling



Vibro tumbling in action



Vibro tumbling parameters

- Media
- Volume
- Frequency
- Time
- Temperature

Media explored on Cu cavities

BIG SIZE MEDIA

1. **Allumina cones** embedded in ureic resin → *high RR*
2. **Stainless steel** → *high RR but contaminate and bend cavity*
3. **SiC** → *powder produced block the RR*
4. **ScotchBrite** → *low RR*
5. **Teflon balls** → *remove contaminants, but embedded in surface*

POWDERS

1. Al_2O_3 → *no effect*
2. $Si_{(am.)}$ and $Si_{(crys.)}$ → *no effect*
3. **Al** → *no effect*
4. B_4C → *no effect*
5. ZrO_2 → *no effect*

Cu working protocol (3 steps)

1. **Al_2O_3 Piramids (Rosler RKG 6 PQ) + Rodastel30** (wet process)
2. **Cu powder 200 mesh** (dry process)
3. **Coconut powder** (dry process)

Cu working protocol (3 steps) - Removing Rates

1. **Al_2O_3 Pyramids (Rosler RKG 6 PQ) + Rodastel30** (wet process)
   High RR → ≈ 5 µm/h

2. **Cu powder 200 mesh** (dry process)
   Polishing effect (remain powders on the surface) → ≈ 0,1 µm/h

3. **Coconut powder** (dry process)
   Polishing effect (Cu powders removal effect) → ≈ 0,3 µm/h

Cu working protocol (3 steps) - Treatments time

1. **Al_2O_3 Pyramids (Rosler RKG 6 PQ) + Rodastel30** (wet process)

   > *2 h → foam production reduce RR and corrosion start (presence of H_3PO_4)*

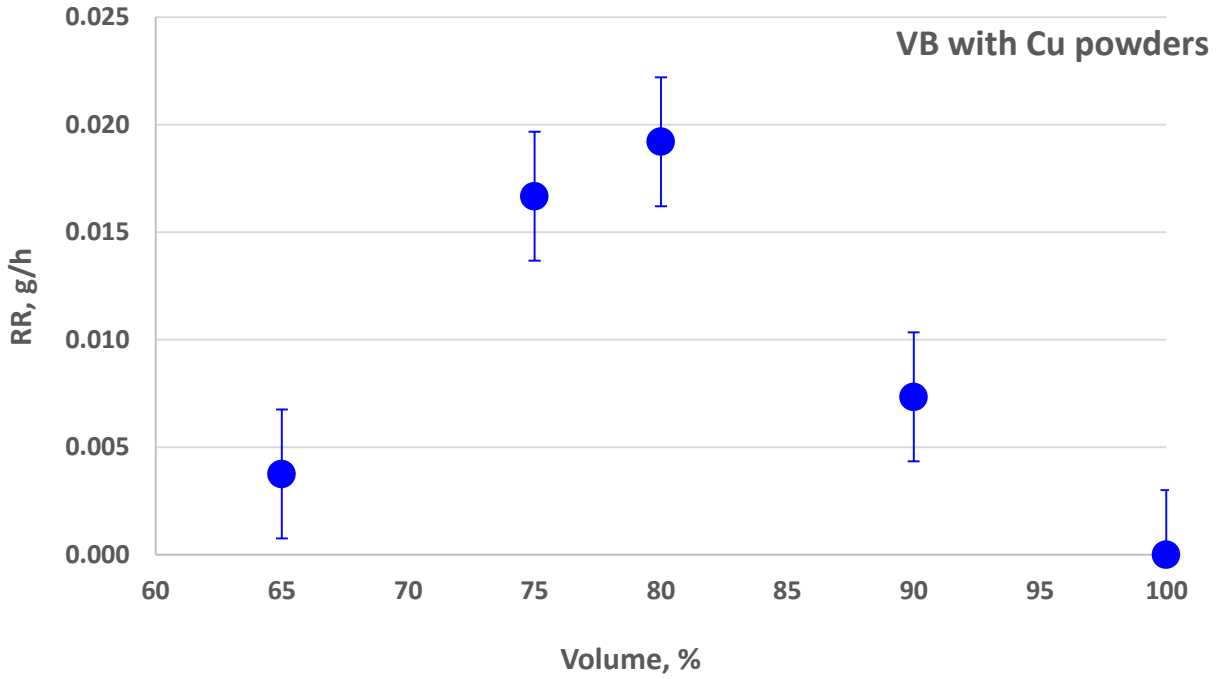
2. **Cu powder 200 mesh** (dry process)

   > *2 hours → pitting starts (Why?)*

3. **Coconut powder** (dry process)

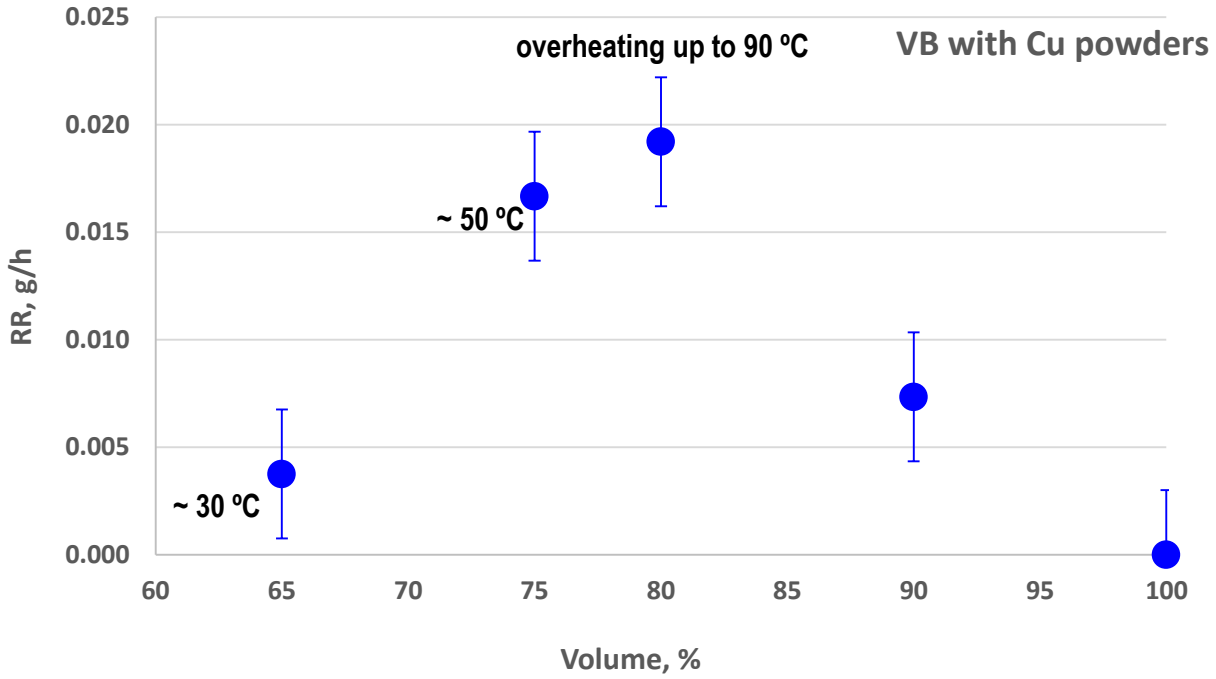
   2 hours

Volume of media



- Influence surface quality and RR
- Very important on Cu powders step

Temperature



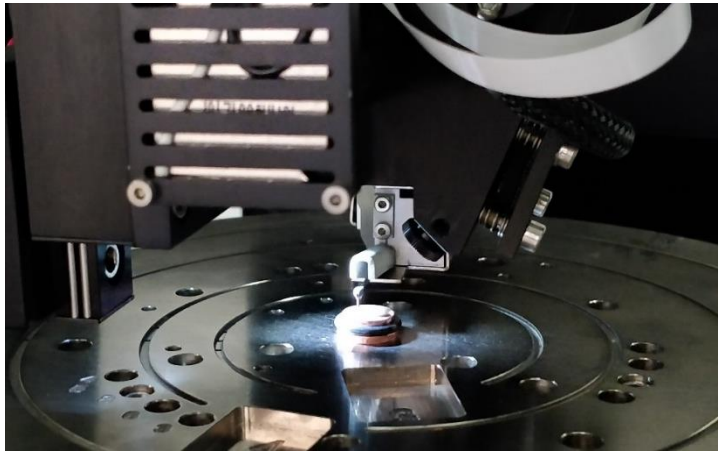
- Step 1 and 3 work at room temperature
- Step 2 produce heating of the cavity → could be use to monitorize the polishing effect

Frequency effect

- Not fully explore yet
- Qualitative speaking, RR increase with frequency
- High and low frequency may damage the vibrotumbling system
- A good compromise is 200 Hz

Results on Coupons

- Test cavity with 2 coupons
- Comparision with grinding polishing
- Roughness characterizations



Vibro-Tumbling - Grinding comparision

Scratched

Ra

500 ± 60 nm

Vibro-Tumbling - Grinding comparision

Scratched

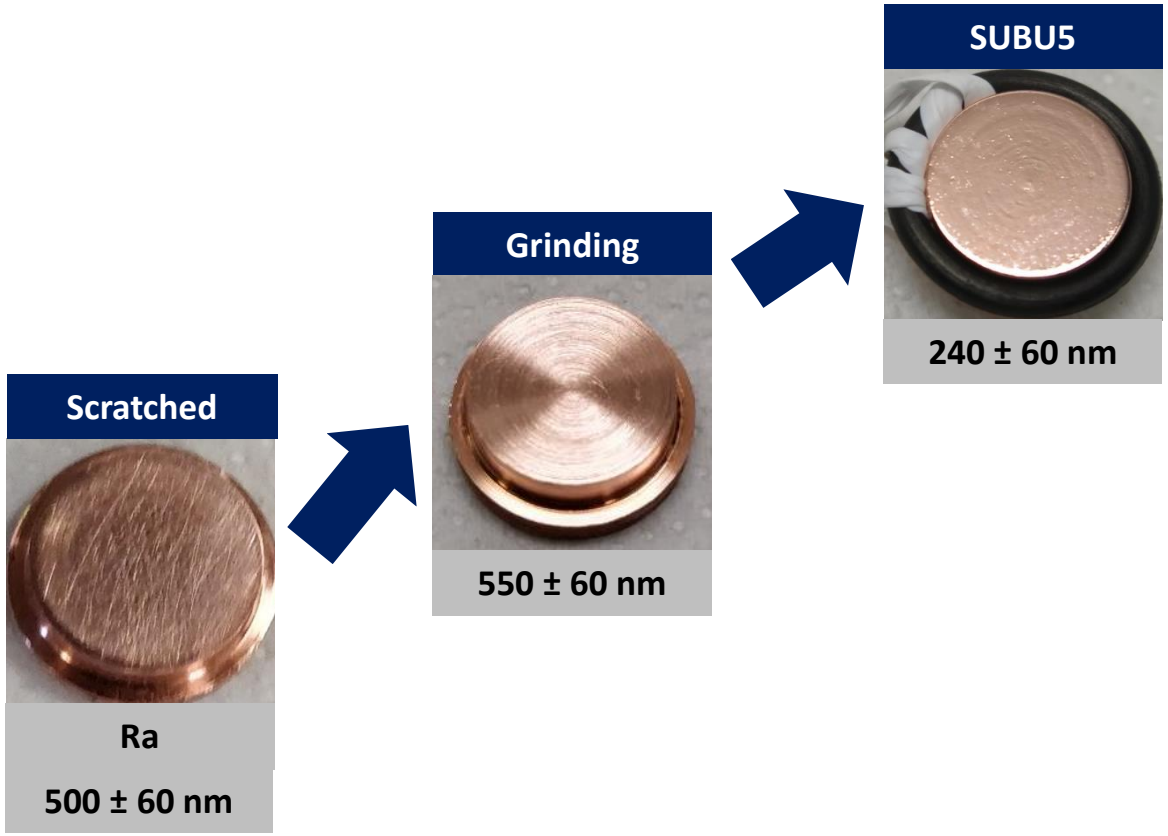
Ra

500 ± 60 nm

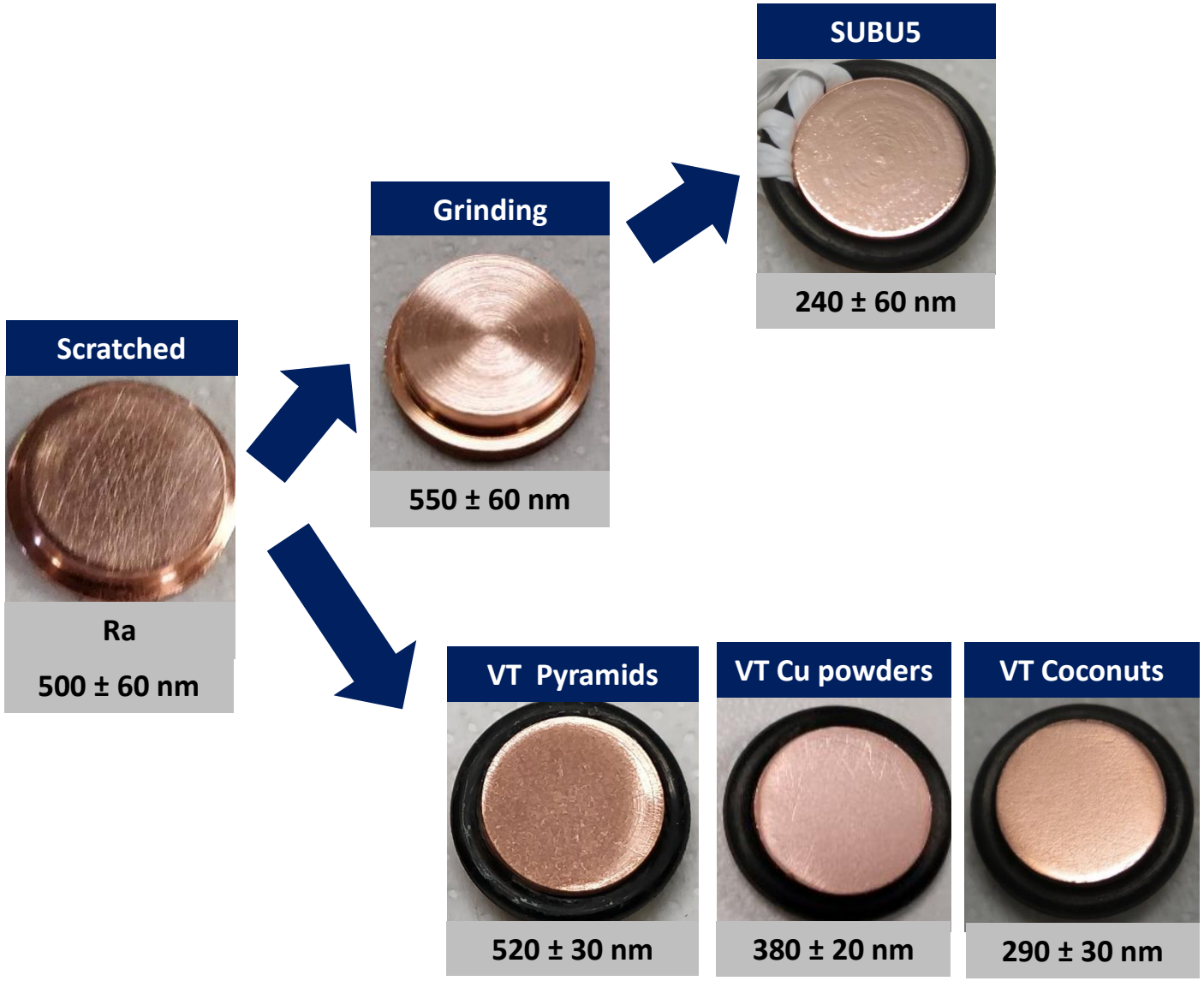
Grinding

550 ± 60 nm

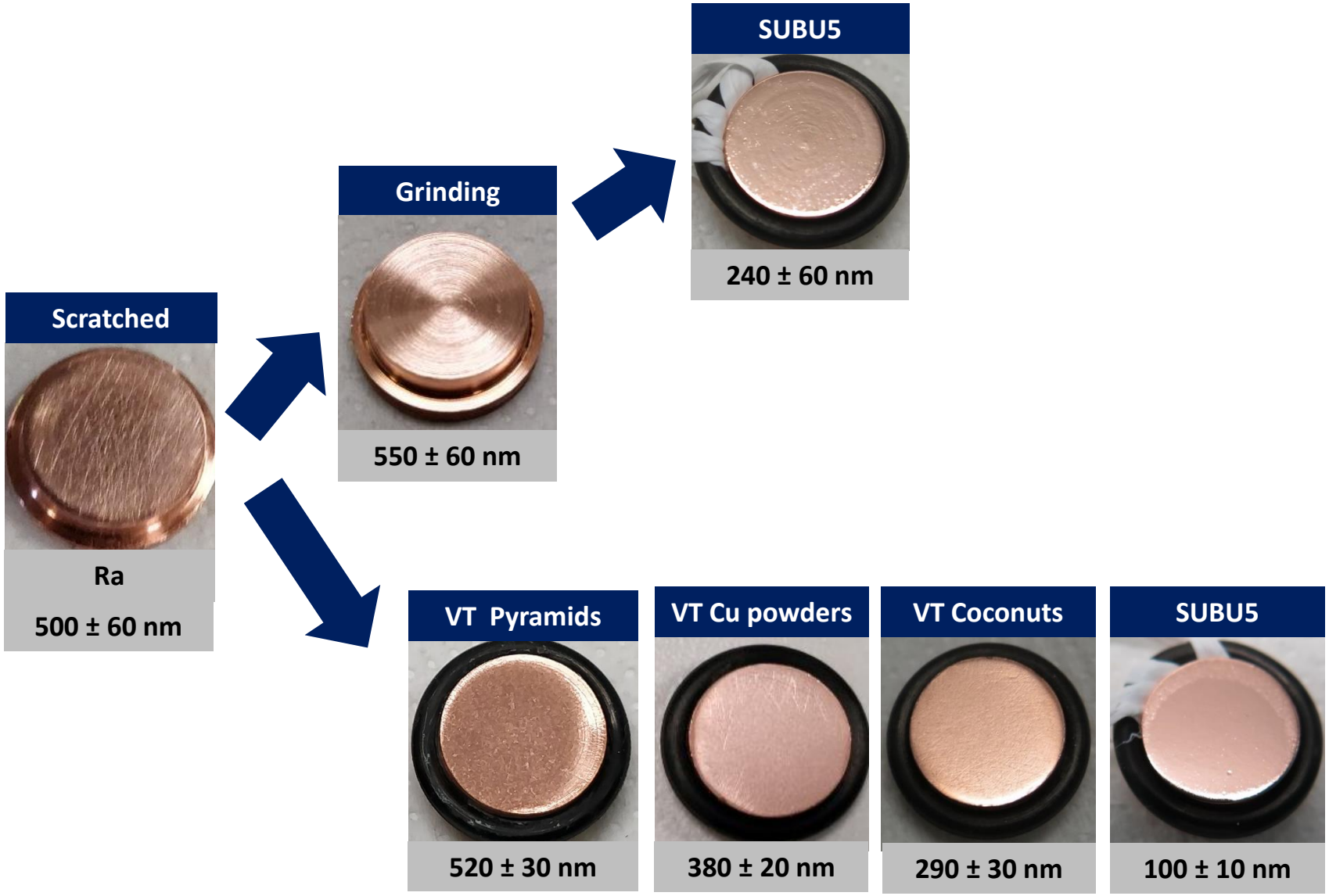
Vibro-Tumbling - Grinding comparision



Vibro-Tumbling - Grinding comparision



Vibro-Tumbling - Grinding comparision



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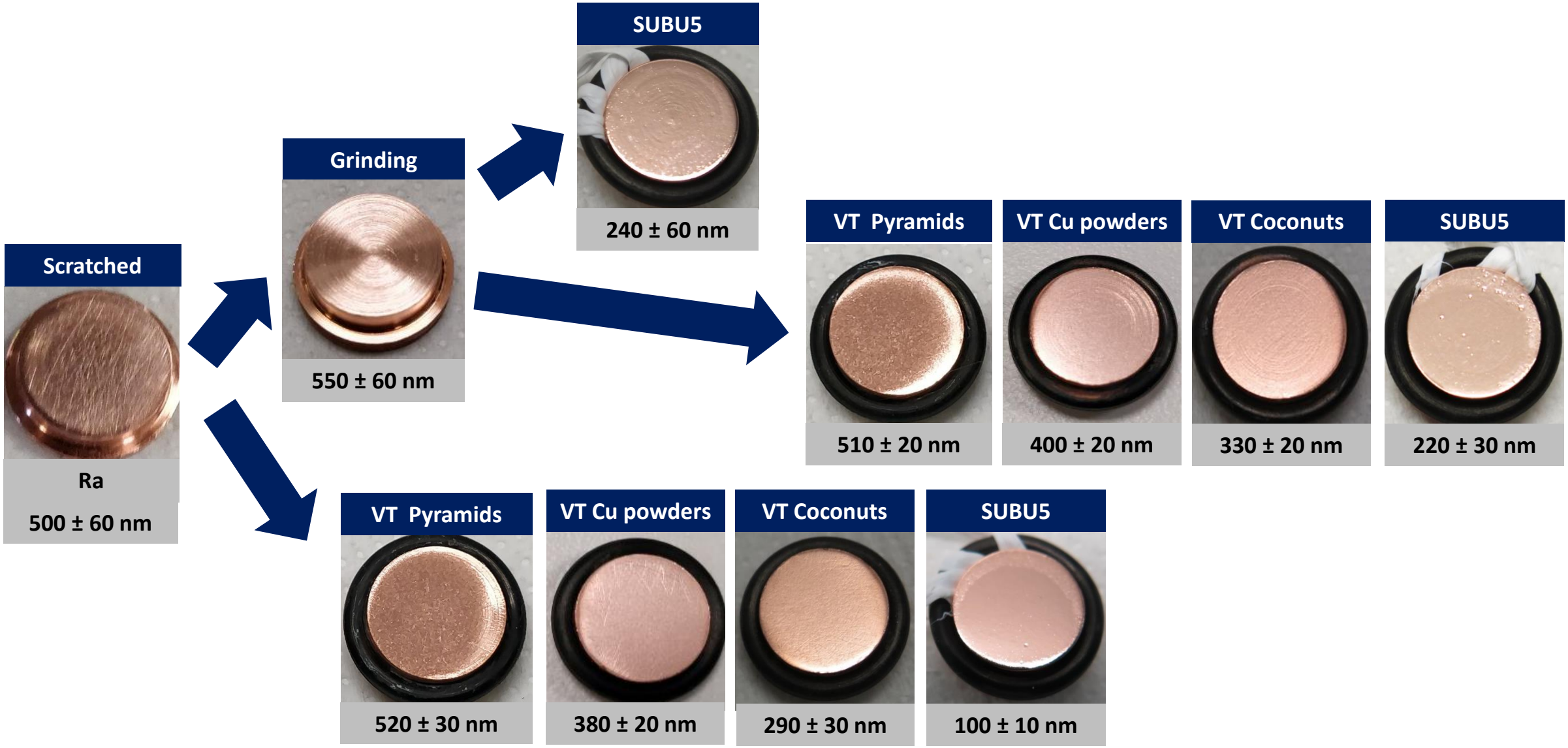
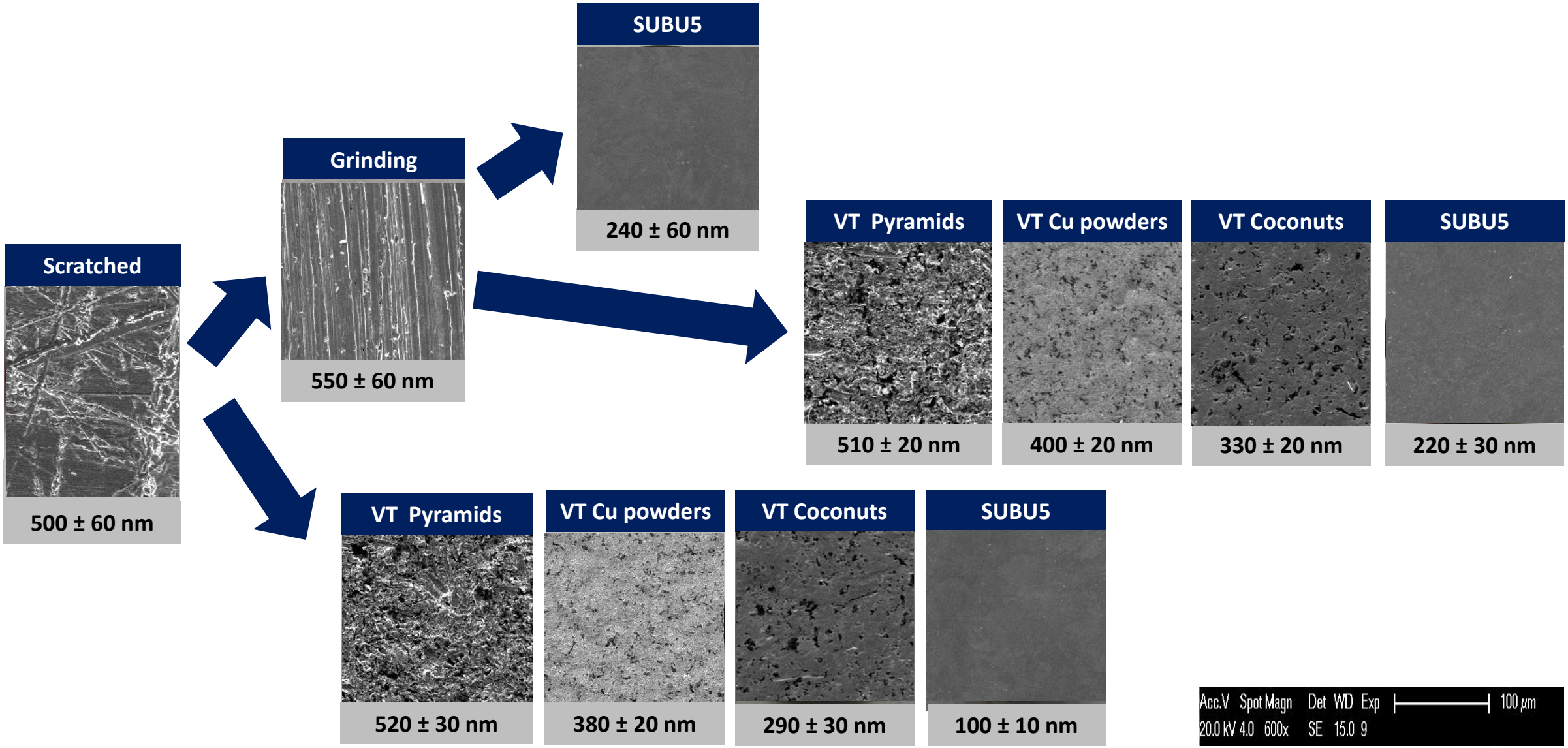
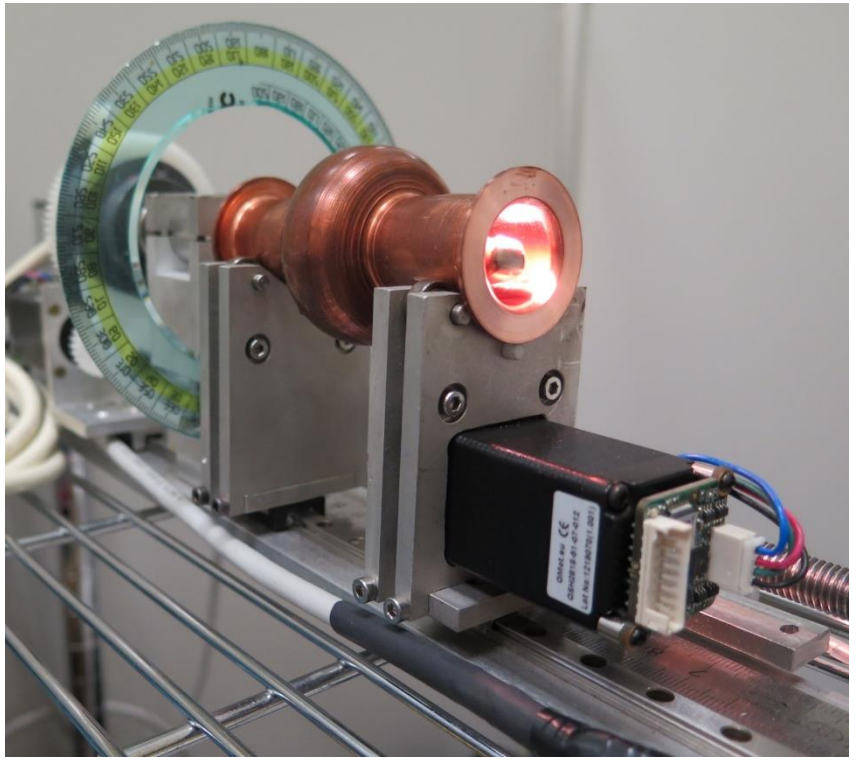


Vibro-Tumbling - Grinding comparision

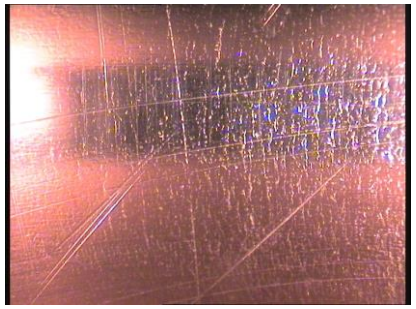
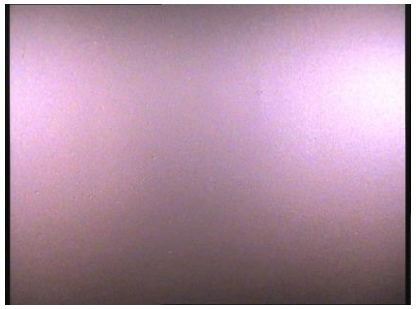
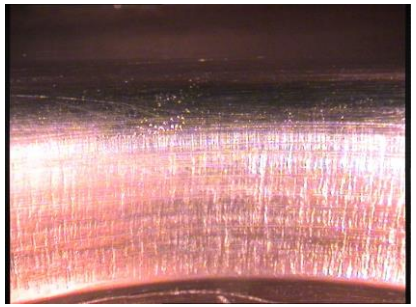
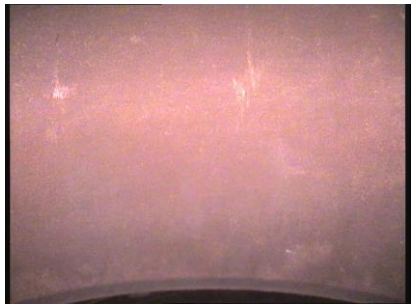
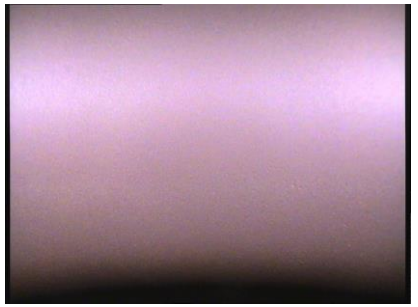
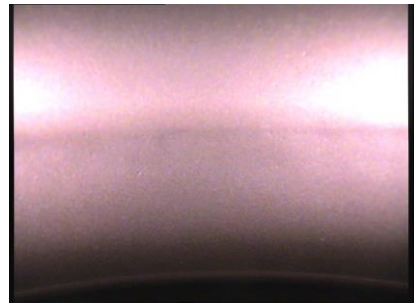
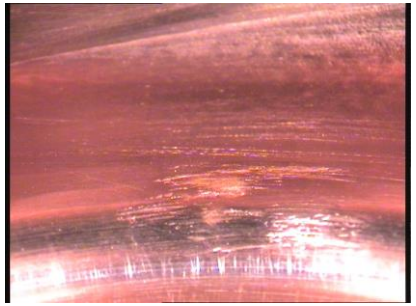
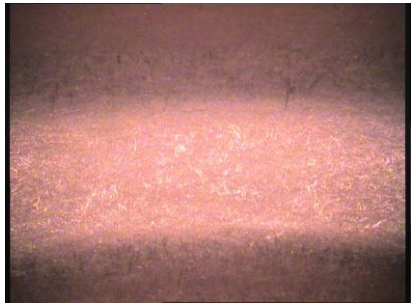
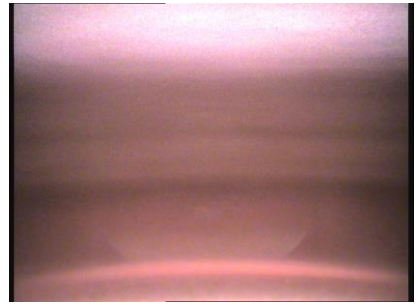


Results on cavities

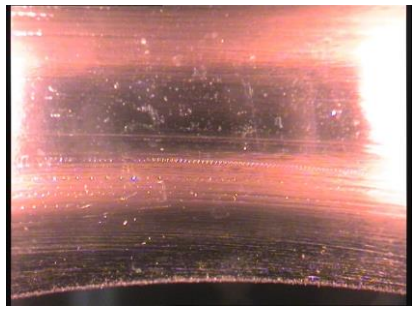
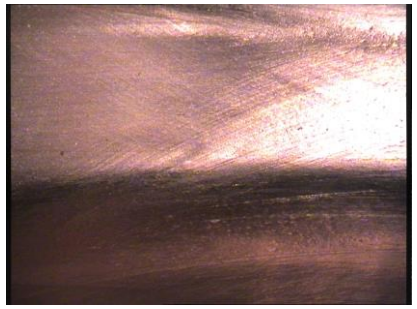
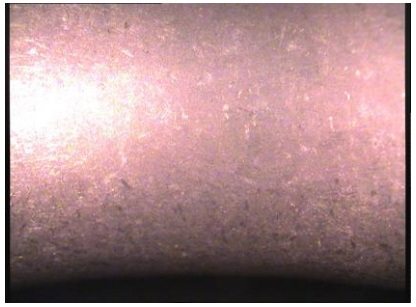
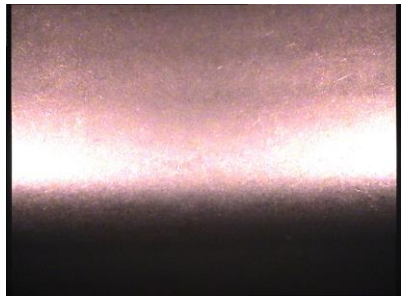
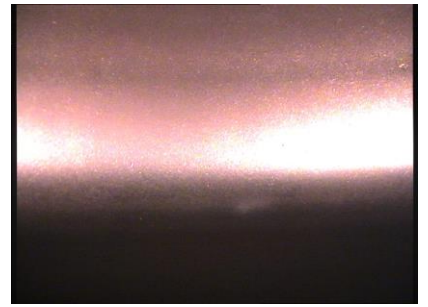
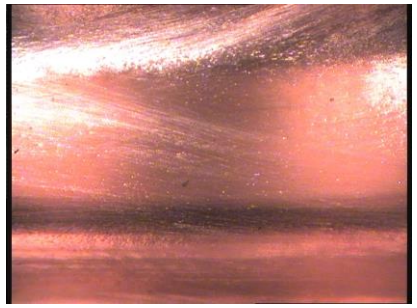
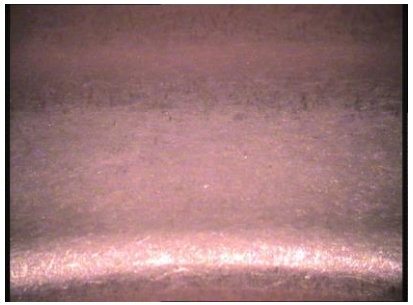
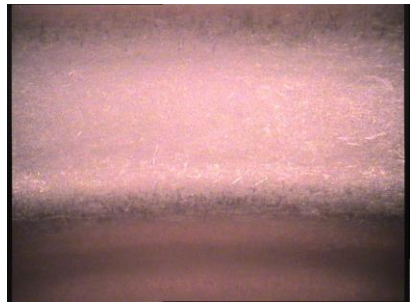
- Results on cavities
- Comparision with grinding on cavities



Cavity #31

	GRINDING	VT – PYRAMIDS (4 h)	VT – Cu Powders (2 h)	VT – Coconut (2 h)
CUT OFF				
IRIS				
CELL				

Cavity #28 Maize instead of Copper powders

	GRINDING	VT – PYRAMIDS (4 h)	VT – Maise (2 h)	VT – Coconut (2 h)
CUT OFF				
IRIS				
CELL				

Conclusions and next steps

- Vibro-tumbling improve the surface finishing compare to grinding with Removing Rates comparable to CBP
- RF tests to test improvement in performance reproducibility
- Scalable to 1,5 - 1,3 GHz

Thank you for the attention!