ARIES

INFN
LNL
Istituto Nazionale di Fisica Nucleare
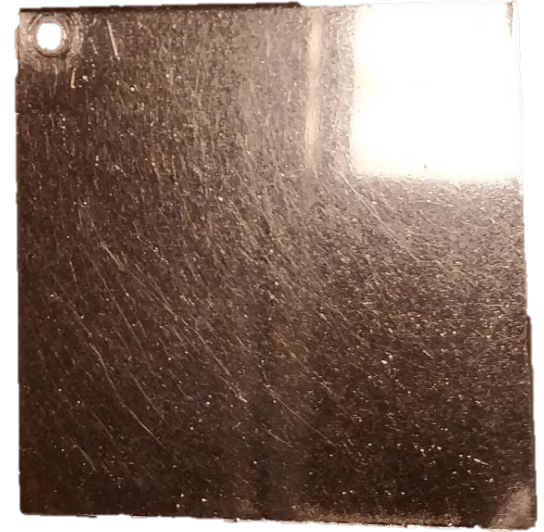Laboratori Nazionali di Legnaro

Cristian Pira

ARIES WP 15.2 progress

ARIES 1st Annual Meeting, 22-25 May 2018, Riga

Tumbling Batch Log

- In order to identify the right treatment conditions tests on similar samples were done during December and January

- On 25/02, during the treatment of the ARIES samples a screw came unscrew and damaged the surface with deep pits and scratches

- On 12/03 CERN dispatched 6 samples to Legnaro (L4 to L9) with the same name on the back side as the original ones

- On 30/03 LNL dispatched 3 treated samples to STFC (L4, L5 and L6)

4. ARIES Samples Tumbling Set Up

- Samples keeped in a sample holder to prevent bending
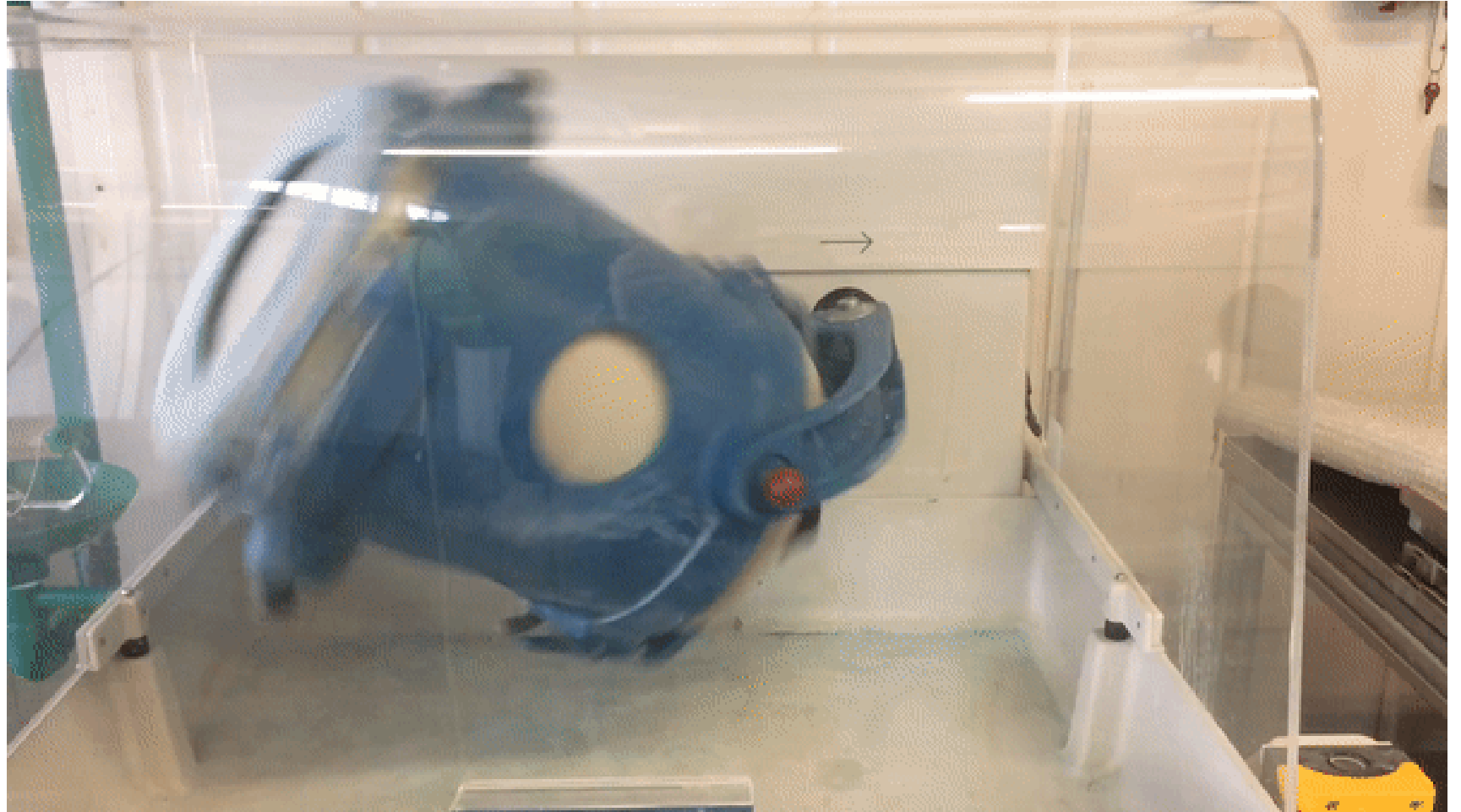
- Two different media used:
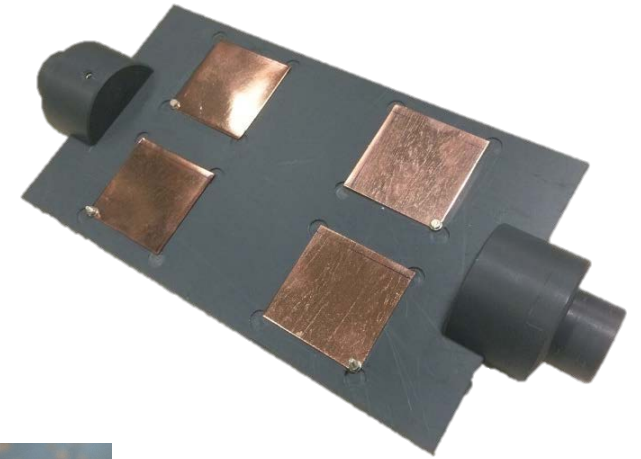
1. Allumina embedded in ureic resin

2. Coconut powders

4. ARIES Samples Tumbling Set Up

3. Tumbling Procedure

- **Degreasing:** NGL 1740 bath 2 hours → 3' ultra-sonic ON at start and again 3' min ultra-sonic ON before end
- **Rinsing with water:** demineralized water for about 1 min
- Polishing: Tumbling with Alumina embedded media and Roadastel30 bath
- **Rinsing with water:** demineralized water for about 1 min
- Polishing: Tumbling with Coconut powders media
- **Degreasing:** Rodastel bath 2 hours → 3' ultra-sonic ON at start and again 3' min ultra-sonic ON before end
- **Rinsing with water:** demineralized water for about 1 min
- **Passivation:** sulfamic acid (H_3NO_3S, 5 g/l) for about 1'
- **Rinsing with water:** demineralized water for about 30s
- **Spaying with alcohol:** ethyl alcohol to enhance drying
- **Drying with N_2.**
- **Packing** in wafer box and then in plastic bag under N_2
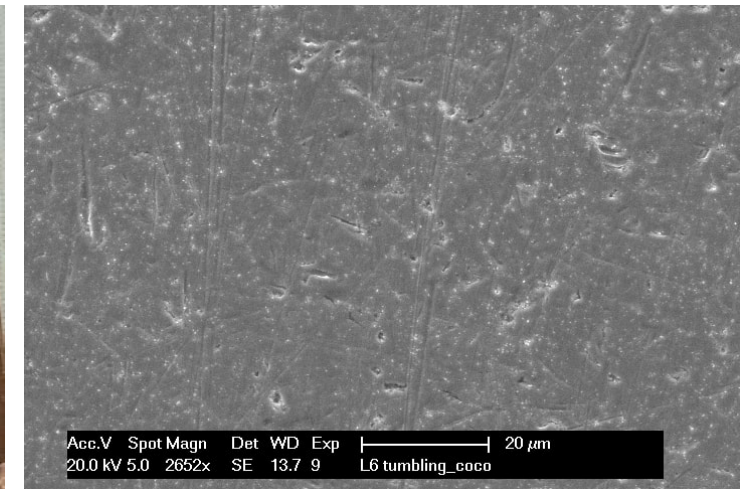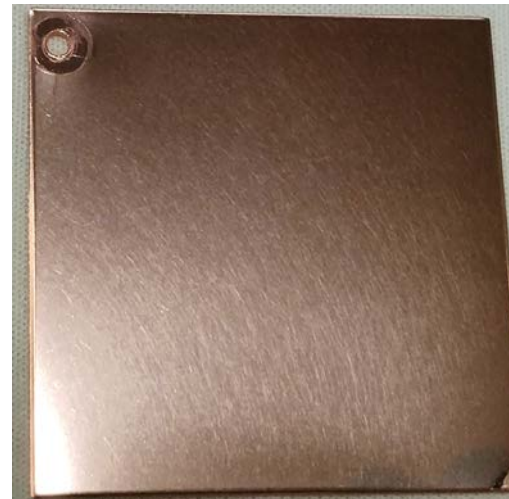
Results

Tumbling with alumina cones
- Time: 21 hours
- Process stop every 2 hours for samples check
- Total etching: 1,1 μm
- Ra: 29 ± 11 nm (Initial Ra: 127 ± 26 nm)
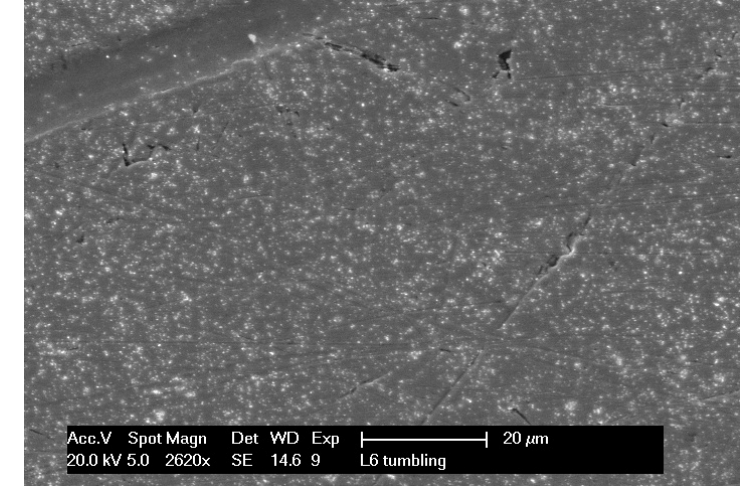
Tumbling with cononut powders
- Time: 17 hours
- Process stop every 2 hours for samples check
- Total etching: 0,5 μm
- Ra: 48 ± 13 nm
- **Less shiny and less scratched**

Surface Characterization

Optical inspection

Initial surface

- Lamination texture

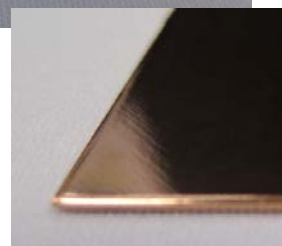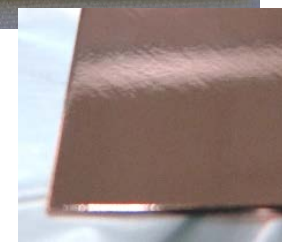| SUBU	EP	EP + SUBU	Tumbling

- **SUBU**
  - Mirror like surface
  - Reflectivity 65 ± 1 %

- **EP**
  - Mirror like surface
  - Texture due to oxigen evolution
  - Reflectivity 64 ± 1 %
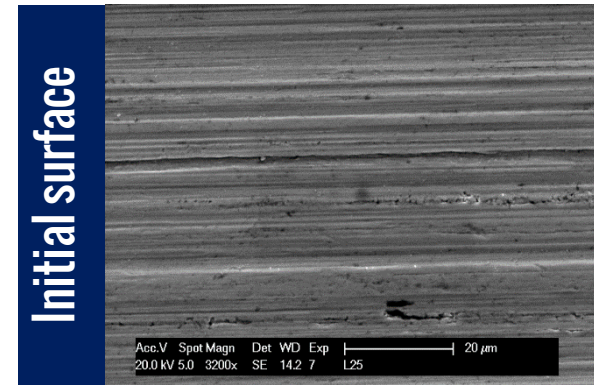
- **EP + SUBU**
  - Mirror like surface
  - Texture due to oxigen evolution reduced by SUBU
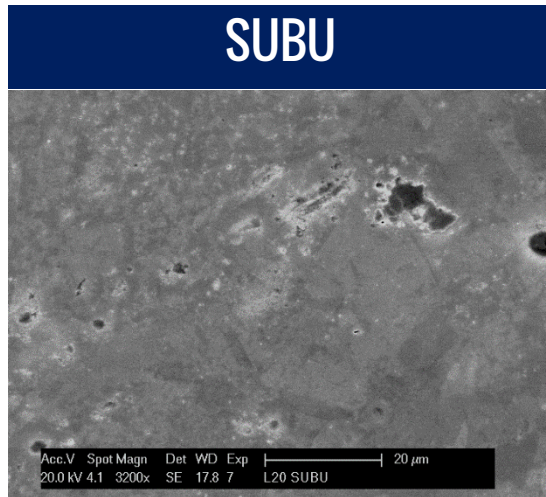 - Reflectivity 66 ± 1 %

- **Tumbling**
  - Shining surface
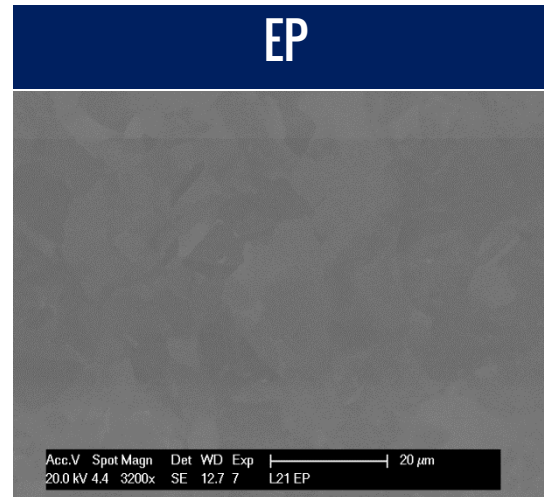 - Small visible scratches on surface
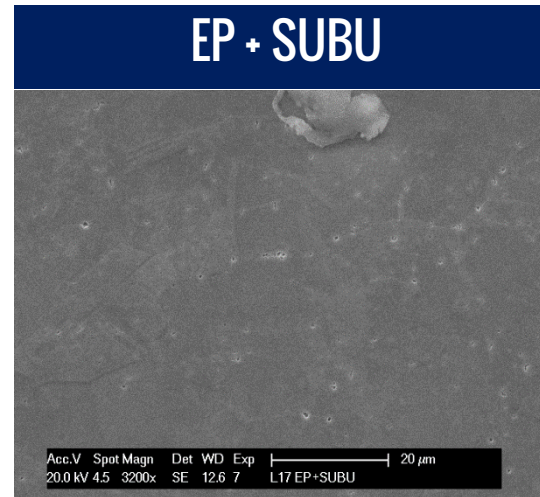 - Reflectivity 52 ± 1 %

SEM Characterization

Initial surface

- Lamination texture

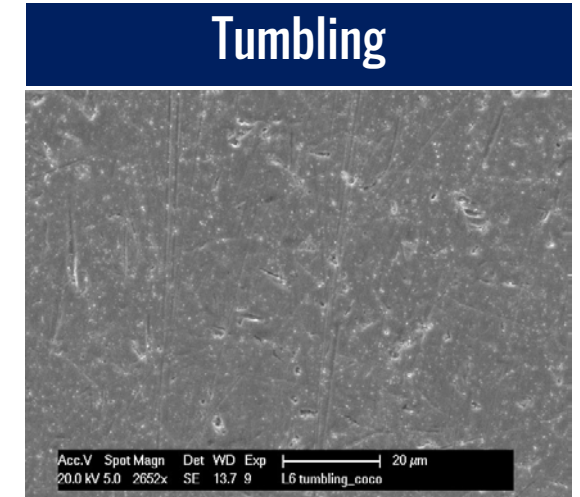| SUBU	EP	EP + SUBU	Tumbling

- Presence of pitting
- No pitting
- Presence of pitting
- Presence of scratches
- Inclusion of media

Roughness

R_a is the arithmetic average deviation from the mean line within the assessment length (L).
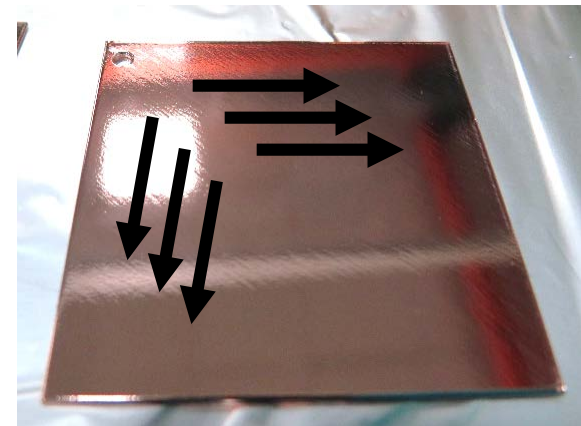
$$R_a = \frac{1}{L} \int_{x=0}^{x=L} |y| \, dx$$

Polishing Treatment	Ra
Initial surface	*130 ± 30 nm*
SUBU5	48 ± 7 nm
EP	225 ± 80 nm
EP+SUBU5	115 ± 80 nm
Tumbling	44 ± 7 nm
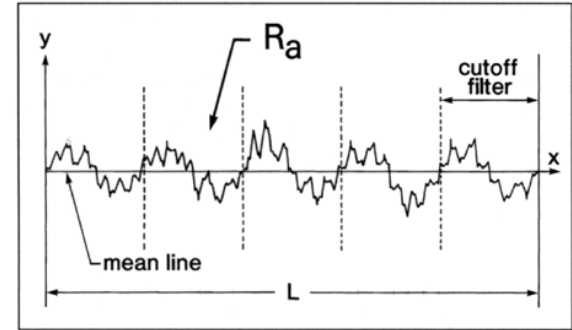
Scan length of 1 mm

Roughness

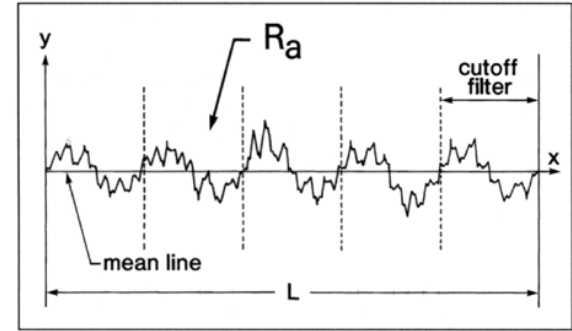R_a is the arithmetic average deviation from the mean line within the assessment length (L).
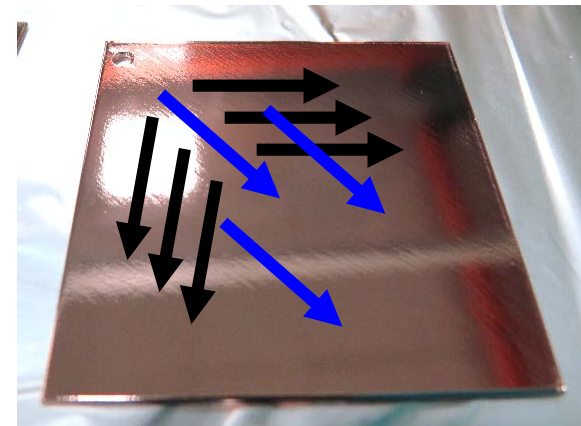
$$R_a = \frac{1}{L} \int_{x=0}^{x=L} |y| \, dx$$

Polishing Treatment	Ra	Ra diagonal
Initial surface	*130 ± 30 nm*	
SUBU5	48 ± 7 nm	
EP	225 ± 80 nm	86 ± 14 nm
EP+SUBU5	115 ± 80 nm	59 ± 9 nm
Tumbling	44 ± 7 nm	

Scan length of 1 mm

Conclusions

- Surface characterizations show that SUBU5 reduces roughness more than the other treatments

- SUBU5 produces pitting on the surface, also if used just for the etching of 5 microns (EP+SUBU)

- EP treated surface does not present pitting, but roughness is influenced by the dynamic of the process

- Tumbling reduces surface roughness at the same values of SUBU5

- Tumbling introduces small scratches on the surface and possible inclusions

- SC characterizations are necessary to evaluate the effect of polishing treatment on Nb thin film