



Status of Laser Cleaning and Polishing, Sample Characterisation

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Sample deposition at INFN

Samples C10, L8, L16, L20, and L21 have been coated with a 3 μm thick Nb film. Succeeding the deposition, the samples have been cut into pieces and sent to project partners for characterization. The below listed procedure and deposition parameters of Table 5 have been applied:

- Unpacking of Sample and directly installing it onto the sample holder.
- Chamber evacuation and baking at 650 °C for more than 40 hours.
- Target conditioning for 5 minutes.
- Subsequent deposition without interruption of the process for 20 min.
- Cooldown for more than 15 hours.
- Opening the chamber and packing the sample into its original storage box.
- Cutting the samples according to the sketch shown in Figure 24.
- Rinsing the pieces in ethanol and dry with nitrogen.
- Packing in PE bags and millipore boxes for shipping.

Roughness

The roughness was measured with a profilometer Veeco Dektat 8, using the same parameters used for Polished.

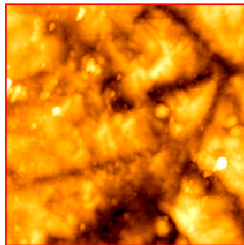
Scan length: 1 mm, applied force 12 mg. 3 scan on 2 different direction (a total of 6 scan) has been done in order to take into account the roll forming texture.

Data dispersion is very high and all samples present similar roughness. Probably, the roughness values are strongly influenced by the sample bending due to cutting. On the other hand this could be due to faceting during the growth of the Nb film.

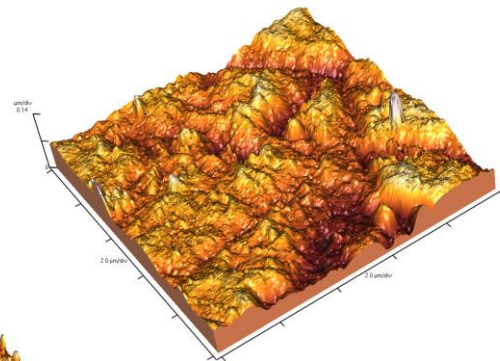
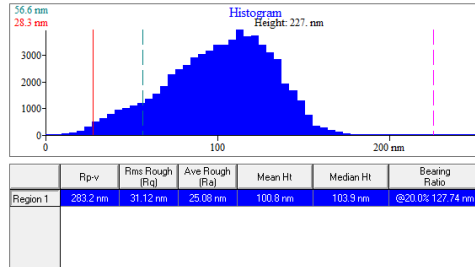
Table 1 Roughness comparison between the five coated samples (from the 1st report)

Sample	Ra	Ra diagonal
SUBU5 CERN (C10)	126 ± 15 nm	
SUBU5 INFN (L20)	197 ± 98 nm	
EP (L21)	233 ± 66 nm	254 ± 50 nm
EP+SUBU5 (L16)	192 ± 64 nm	96 ± 18 nm
Tumbling (L8)	207 ± 53 nm	

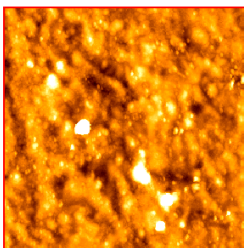
L8



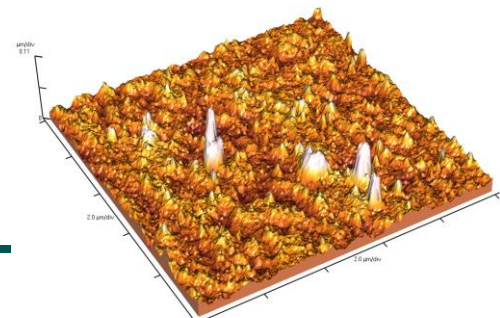
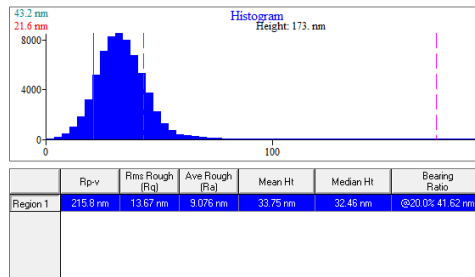
(255,254) x: 9.96 μm y: 9.922 μm z: 0.1364 μm



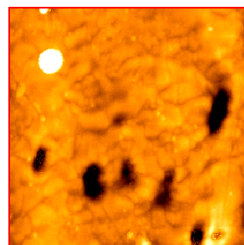
C10



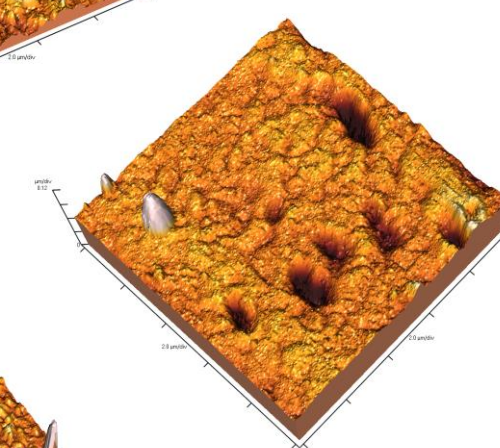
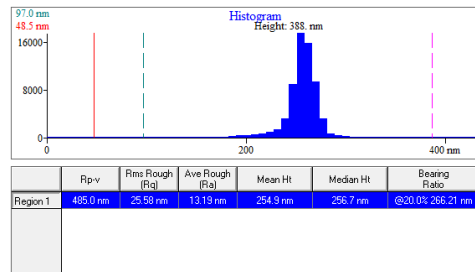
(252,256) x: 9.84 μm y: 10.00 μm z: 0.5623 μm



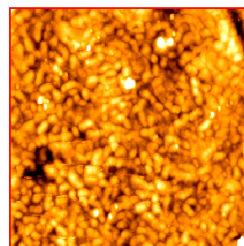
L16



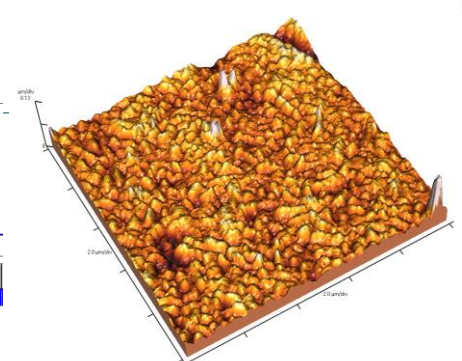
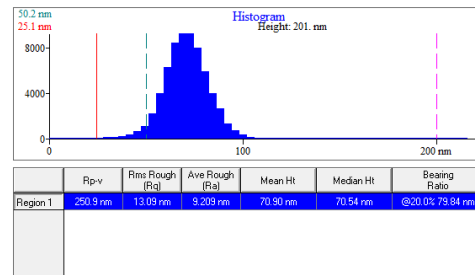
(253,254) x: 9.88 μm y: 9.922 μm z: 0.2427 μm



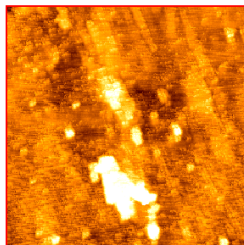
L20



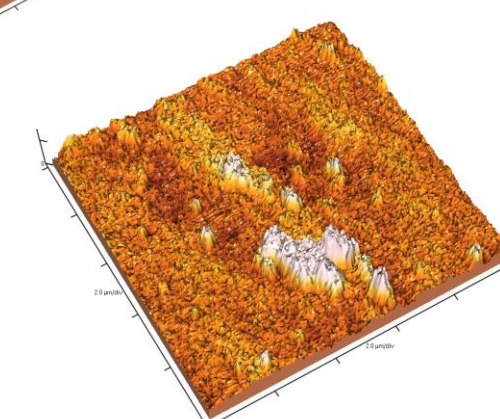
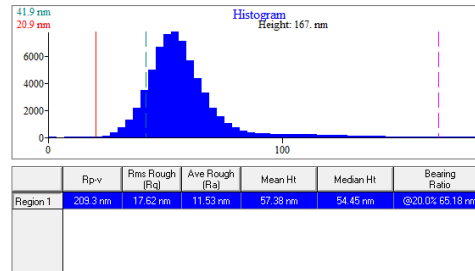
(254,2) x: 9.92 μm y: 0.07813 μm z: 0.07094 μm



L21



(252,256) x: 9.84 μm y: 10.00 μm z: 0.7158 μm



Roughness

The roughness was measured with a *VEECO CP II Scanning Probe Microscope*

Table 1 Roughness comparison between the five coated samples

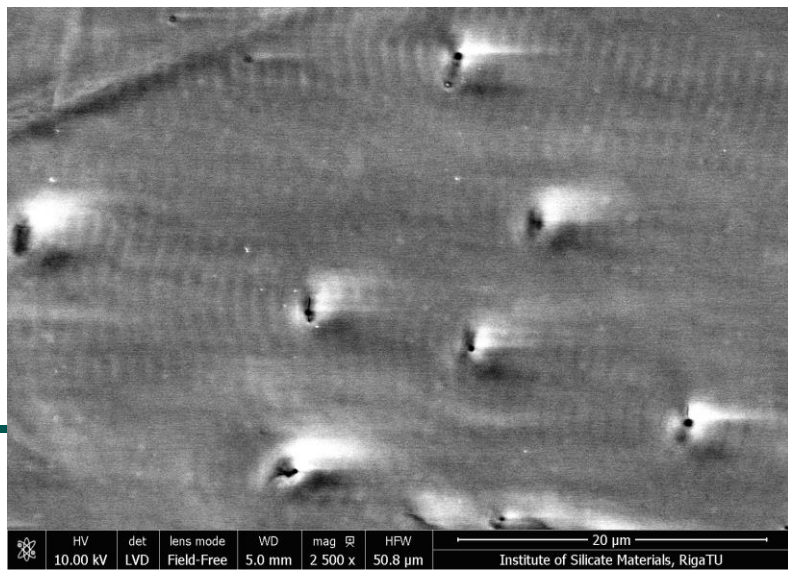
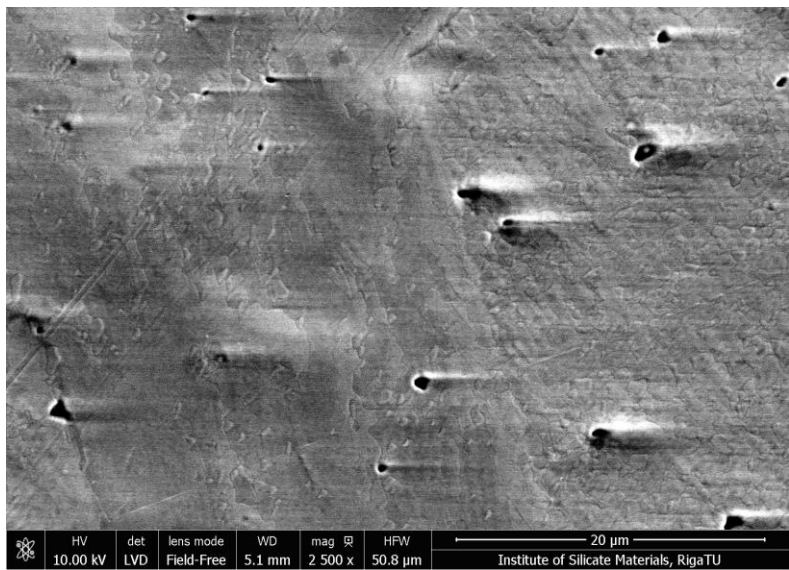
Sample	Ra	Ra by AFM in RTU
SUBU5 CERN (C10)	126 ± 15 nm	9 nm
SUBU5 INFN (L20)	197 ± 98 nm	9 nm
EP (L21)	233 ± 66 nm	12 nm
EP+SUBU5 (L16)	192 ± 64 nm	13 nm
Tumbling (L8)	207 ± 53 nm	25 nm

Experimental

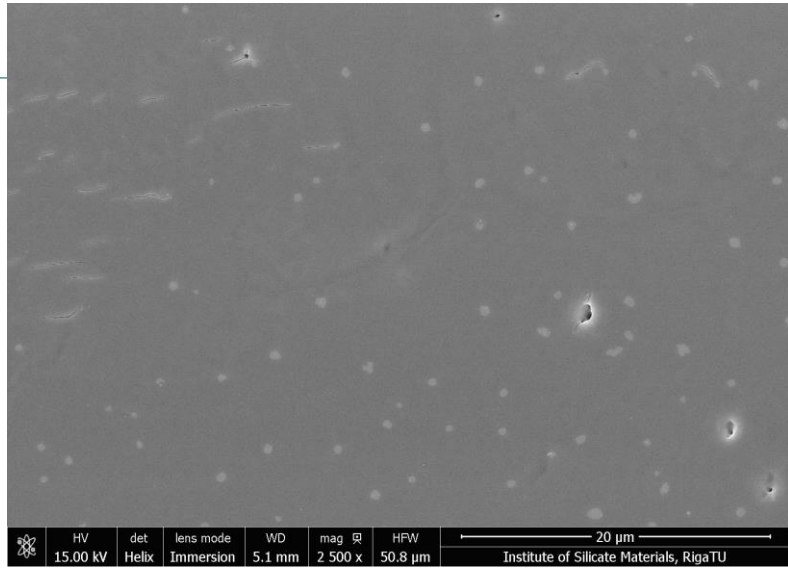
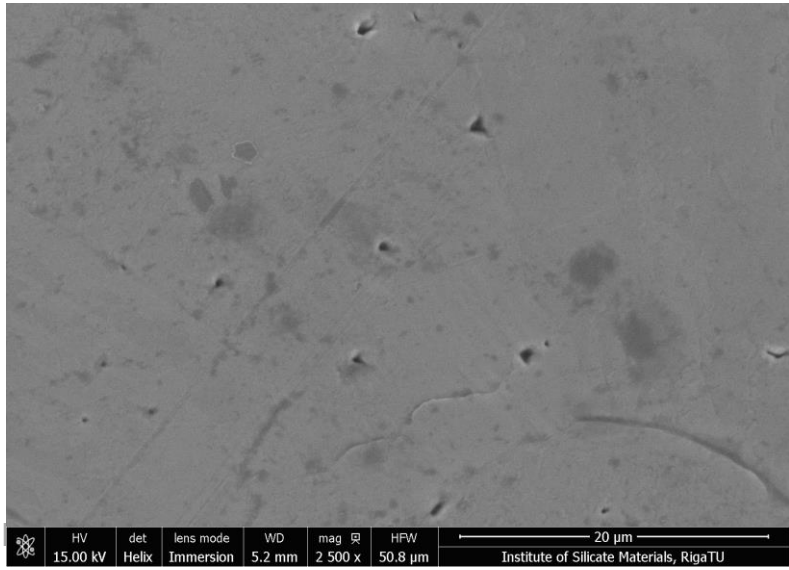
The samples C10, L8, L16, L20, L21 were irradiated by pulsed Nd:YAG laser ($\lambda=1.064\ \mu\text{m}$, $\tau=6\ \text{ns}$ and intensity up to $200\ \text{MW}/\text{cm}^2$) in scanning mode with step $5\ \mu\text{m}$ in Ar atmosphere.



Lens mode: Field-Free



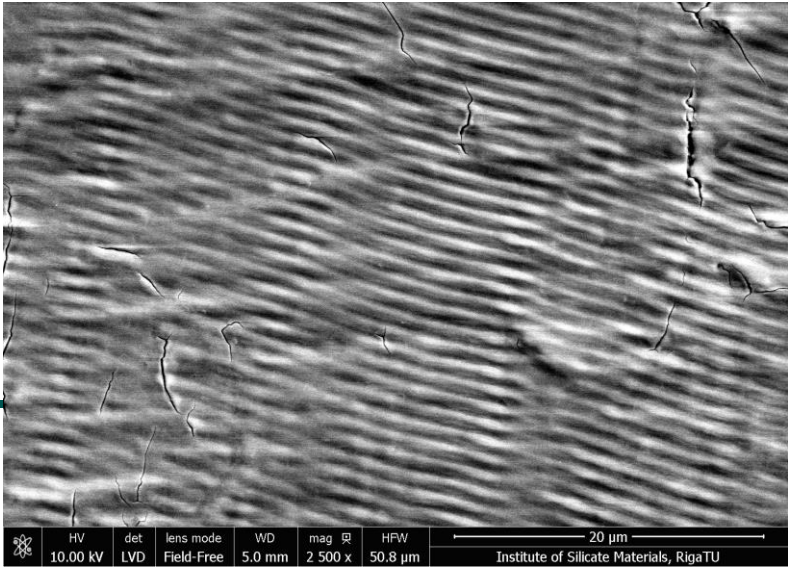
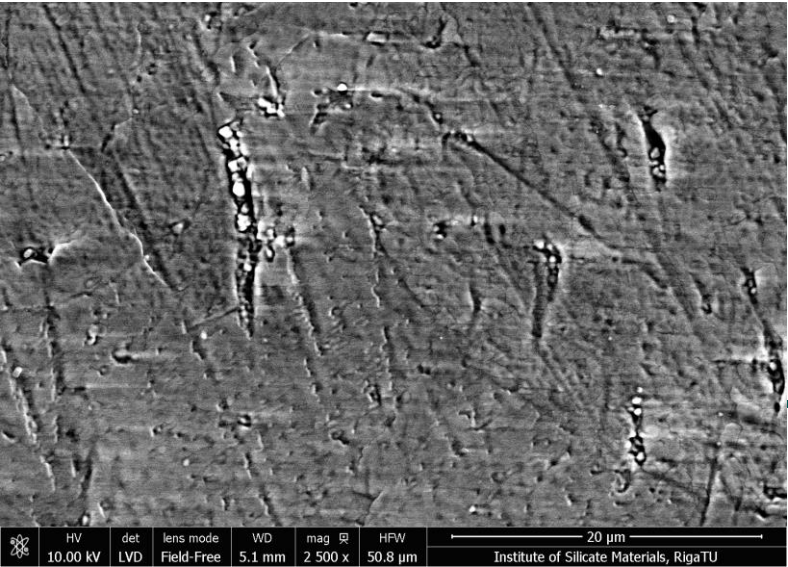
Lens mode: Immersion



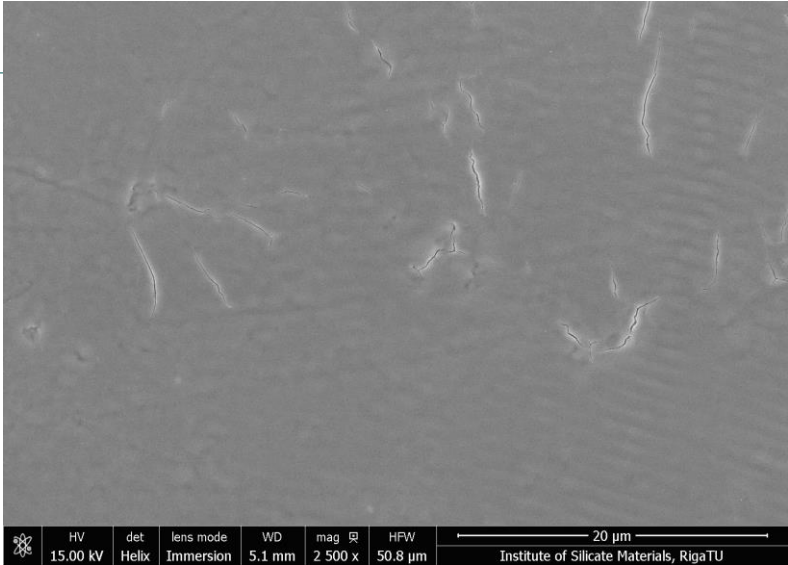
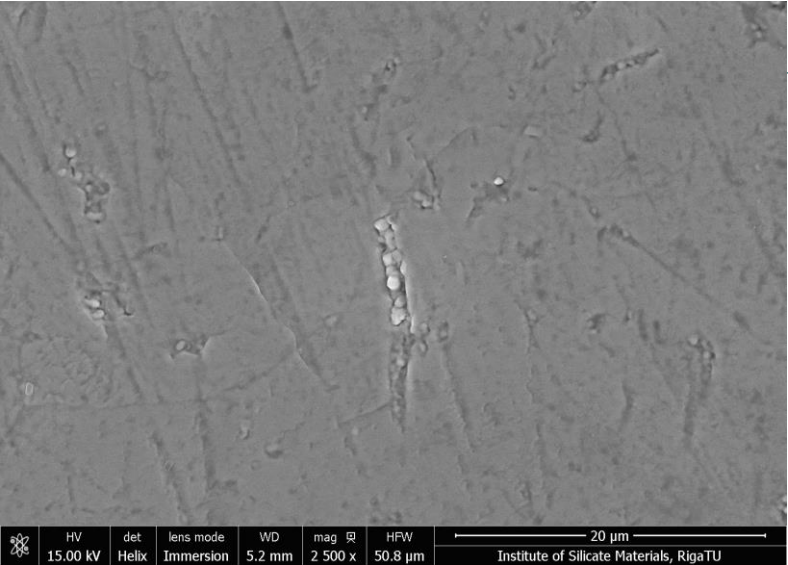
Non-irradiated

Irradiated by Nd:YAG laser

Lens mode: Field-Free



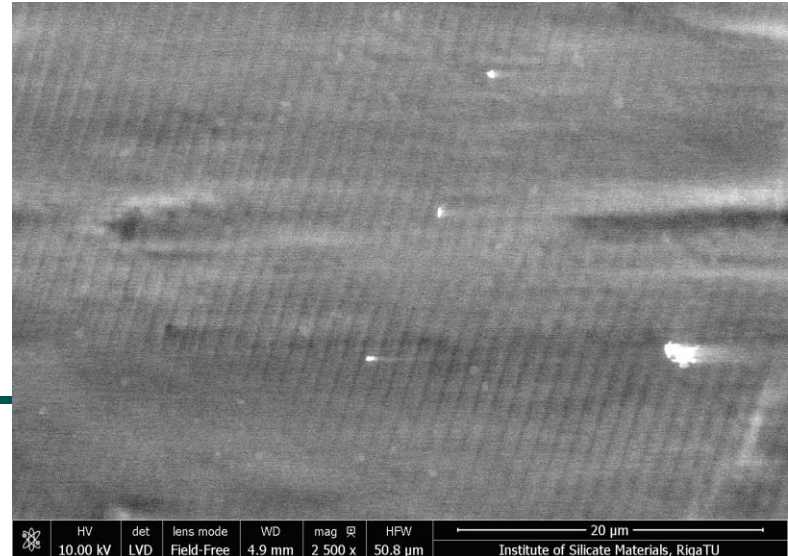
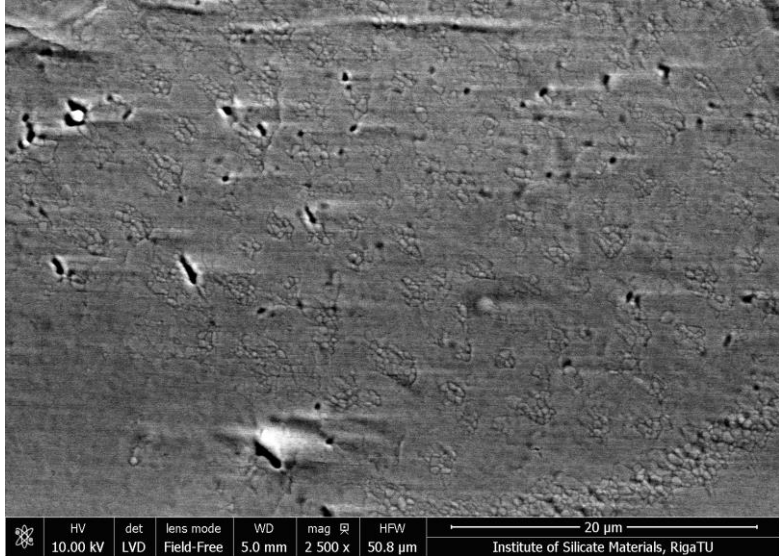
Lens mode: Immersion



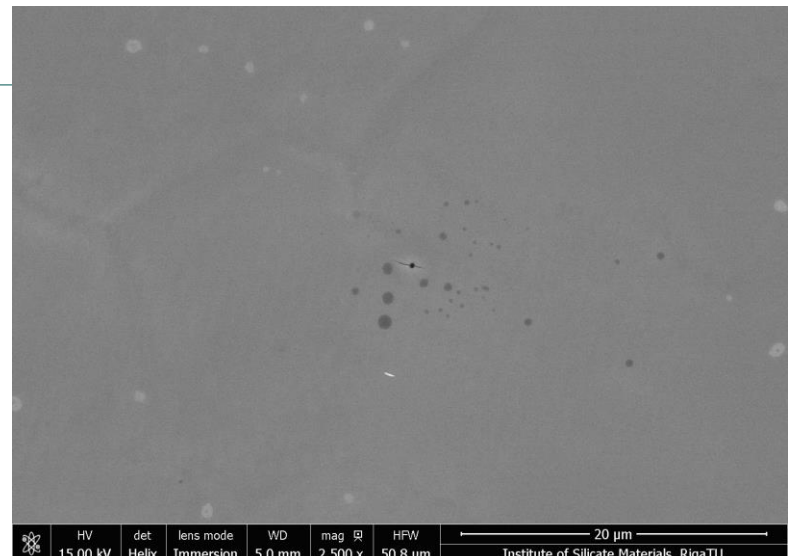
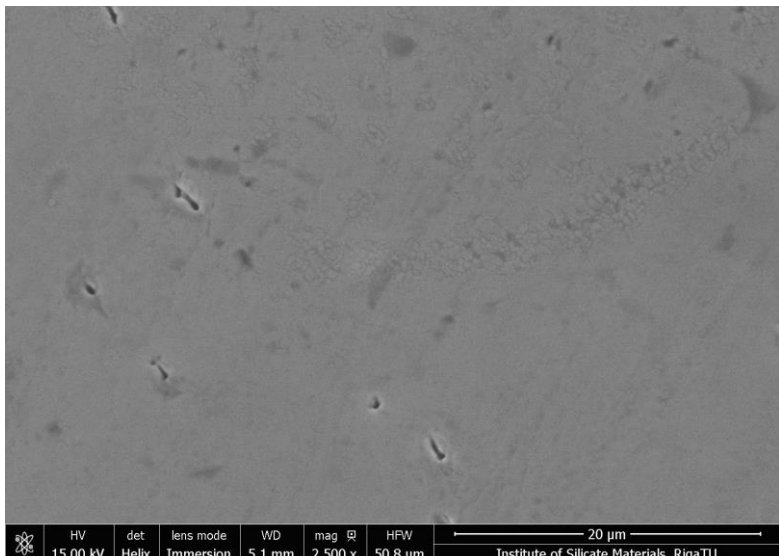
Non-irradiated

Irradiated by Nd:YAG laser

Lens mode: Field-Free



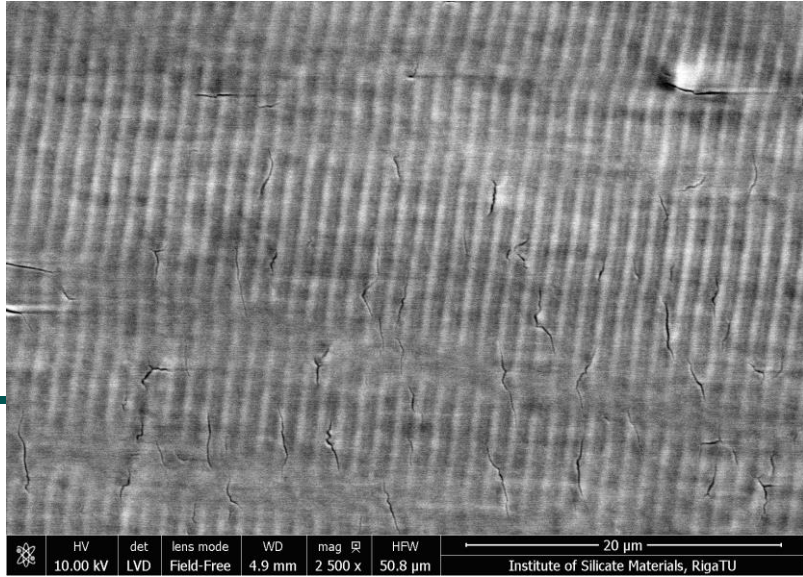
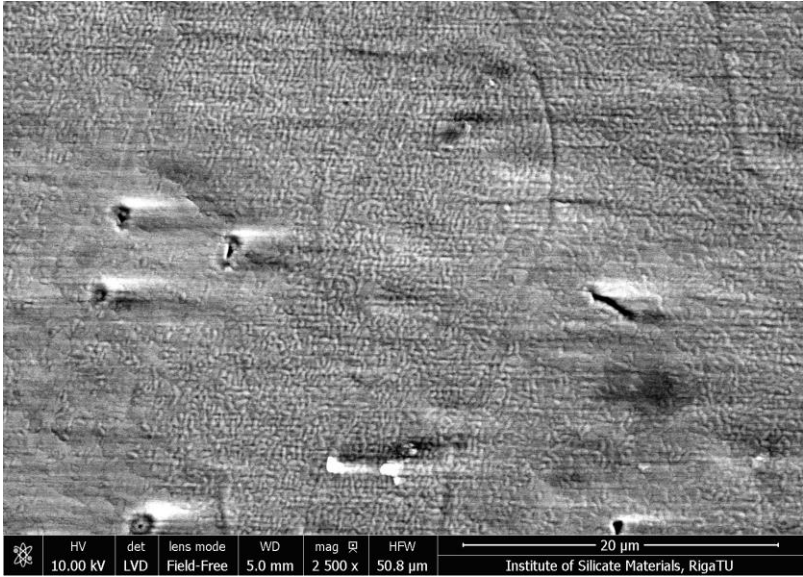
Lens mode: Immersion



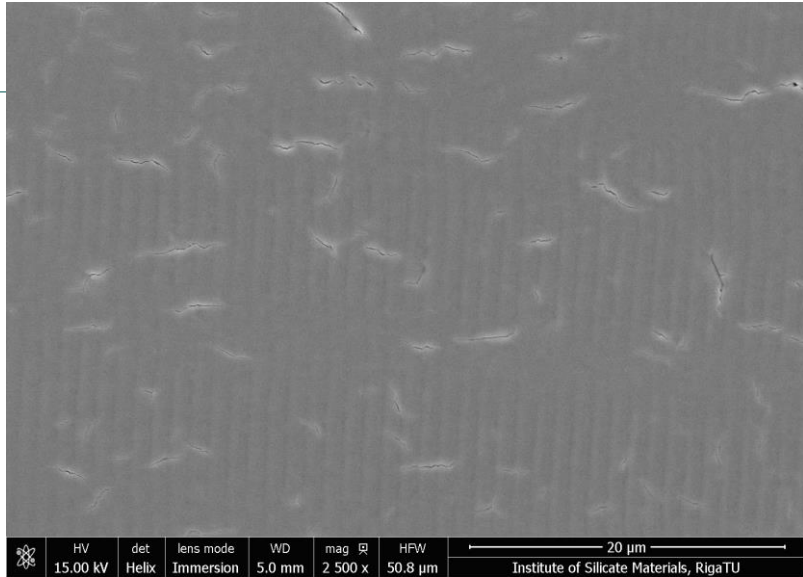
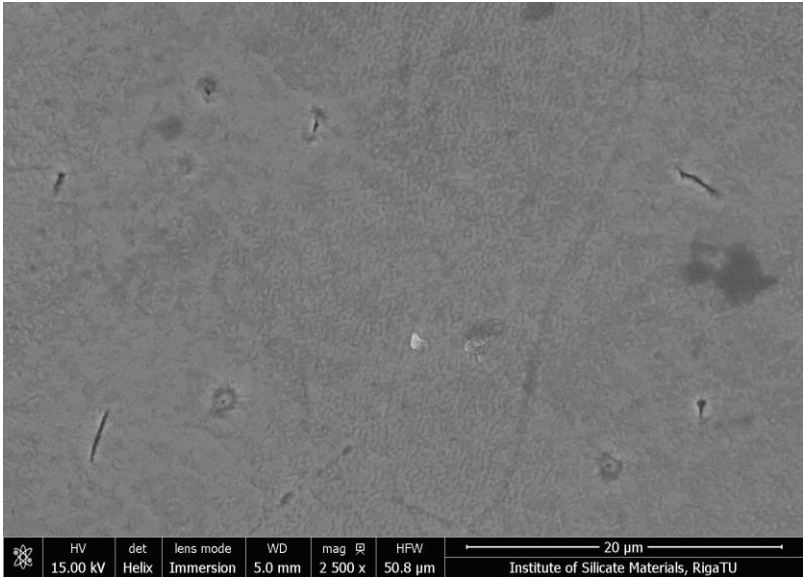
Non-irradiated

Irradiated by Nd:YAG laser

Lens mode: Field-Free



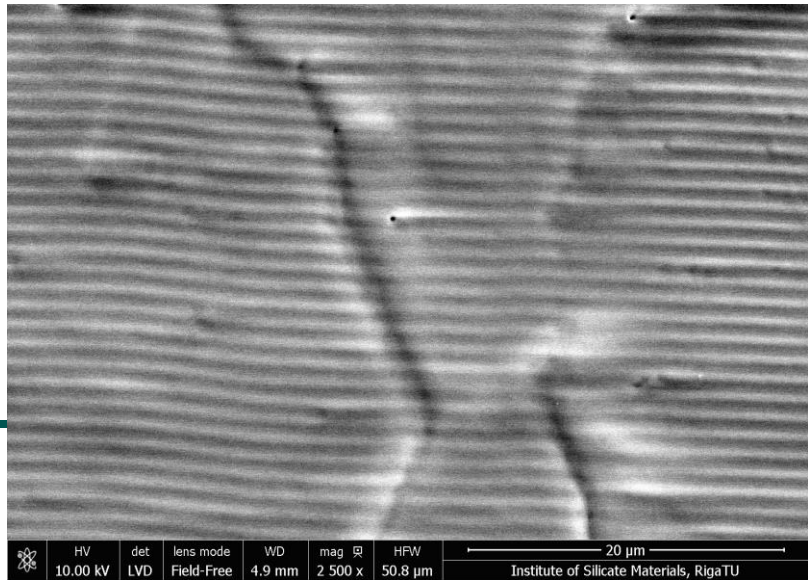
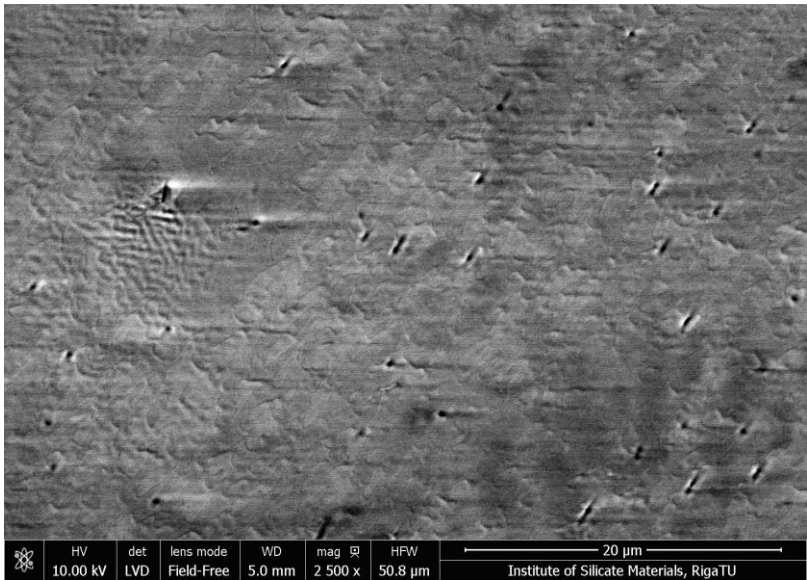
Lens mode: Immersion



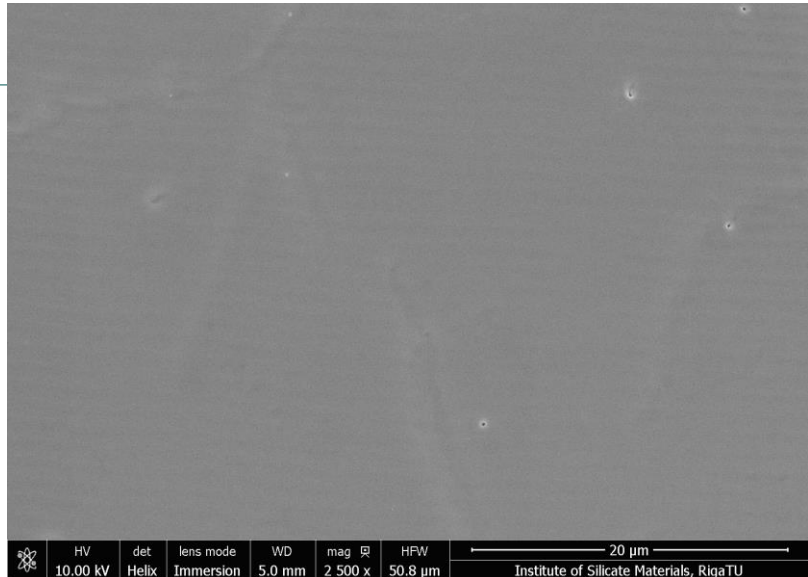
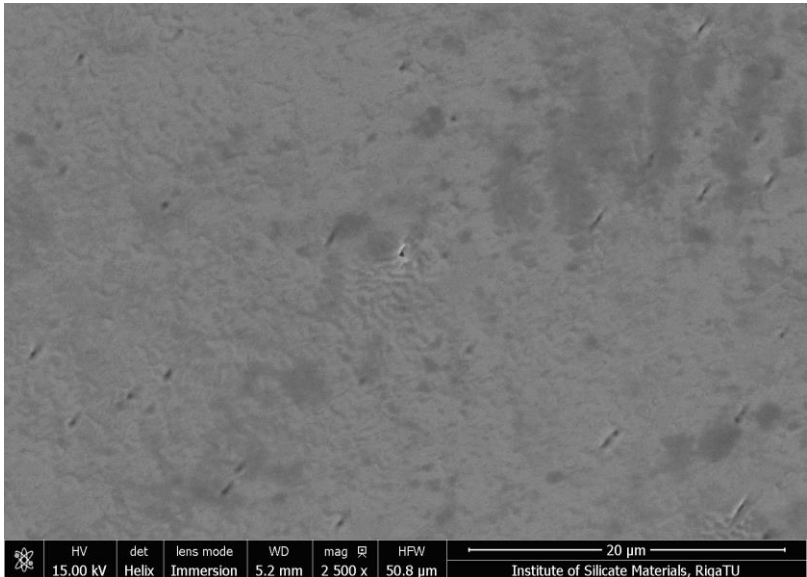
Non-irradiated

Irradiated by Nd:YAG laser

Lens mode: Field-Free



Lens mode: Immersion



Conclusions

Characterization of the samples:

1. Typical for Nb/Cu samples (C10, L16) is the presence of pinholes with size up to 500 nm.
2. Only for the sample L8 the surface is characterized by chaotically distributed scratches with length up to 10 μm .
3. For the sample L21 the pinholes are longitudinal and orientated with length up to 5 μm .
4. After irradiation by pulsed Nd:YAG laser ($\lambda = 1.064 \mu\text{m}$, $\tau = 6 \text{ ns}$ and intensity up to $I = 200 \text{ MW/cm}^2$) in scanning mode with step $5 \mu\text{m}$ in Ar atmosphere for the samples C10, L8, L16, L20, L21 longitudinal pinholes fully disappeared and appeared periodical structure - Laser-Induced Periodic Surface Structures (LIPSS) with period 1 μm and amplitude up to 5 nm.
5. After irradiation by laser, the surfaces became smoother, but with cracks up to 5 μm length. Pinholes and cracks in the sample L21 fully disappeared.

Thank you for your attention!