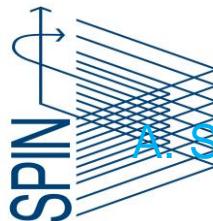




Synthesis and study of TI-1223 Superconducting thin-films for the CERN FUTURE CIRCULAR COLLIDER beam screen



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TU-WIEN, USTEM, ATOMINSTITUT, WIEN, AUSTRIA



S. Calatroni

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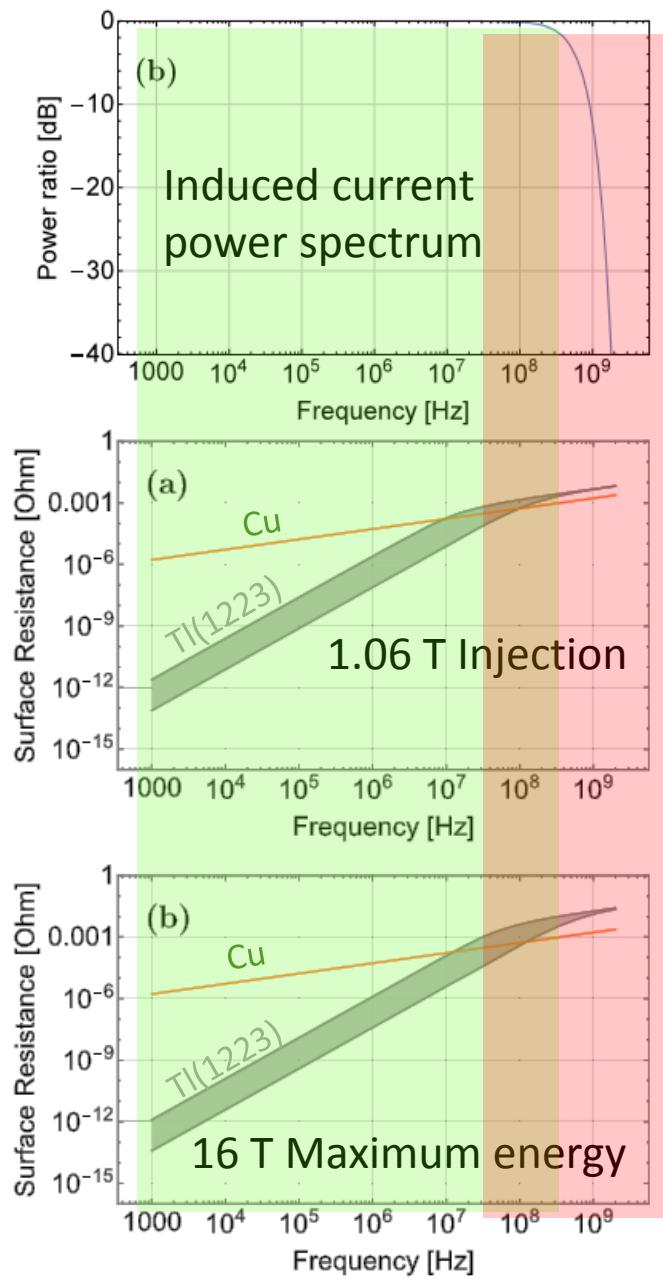
EASITrain – European Advanced Superconductivity Innovation and Training. This Marie Skłodowska-Curie Action (MSCA) Innovative Training Networks (ITN) receives funding from the European Union's H2020 Framework Programme under grant agreement no. 764879.

- Introduction
- Thallium 1223 Bulk samples
- Synthesis and results of Thin films
- Conclusion

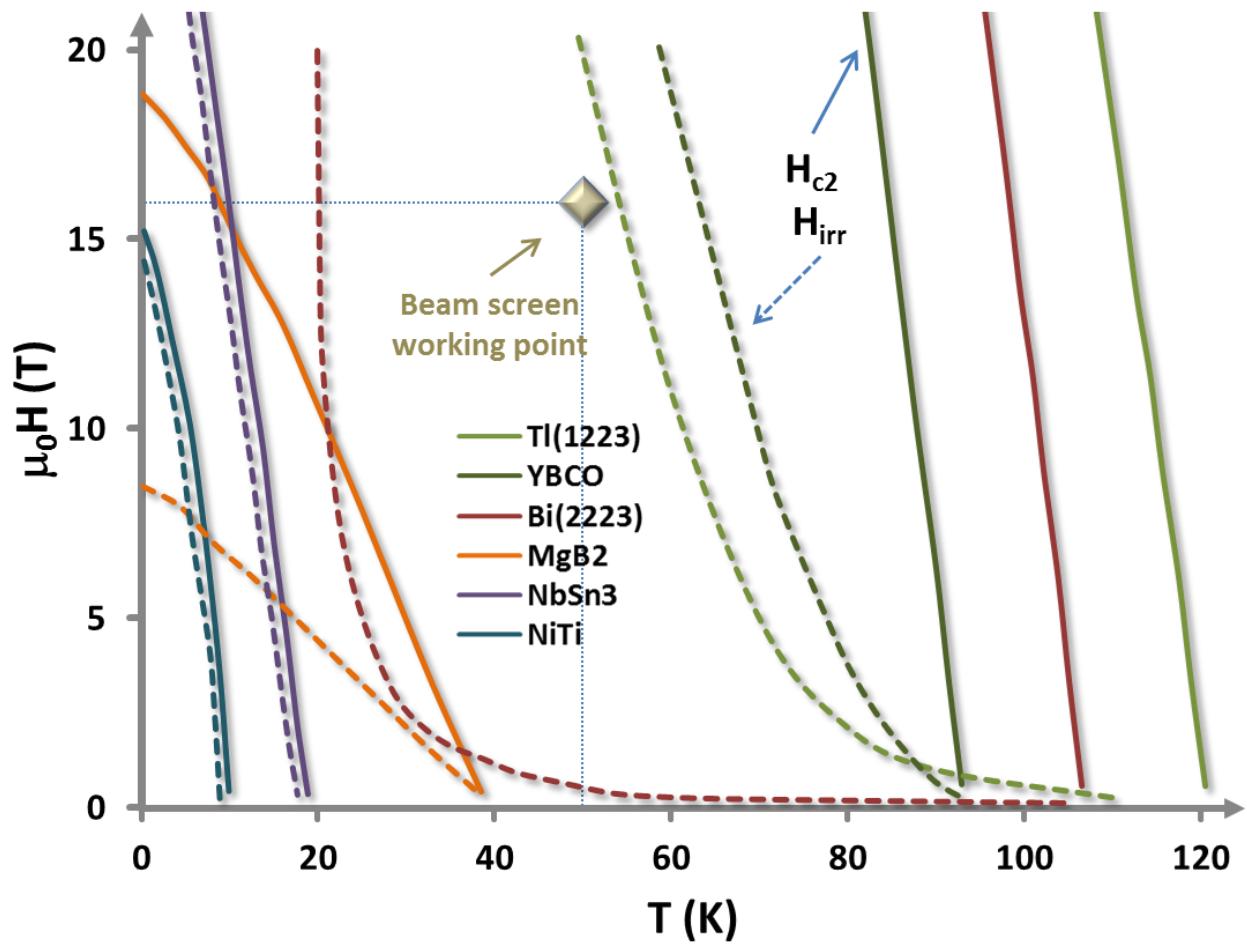
Requirements for the FCC beam screen

- Operation temperature
 $T=50\text{ K}$
- Magnetic field
 $B=16\text{ T}$
- Frequency
 $\nu=1\text{GHz}$
- Boundary materials with 100 TeV particles
- High synchrotron radiation intensity



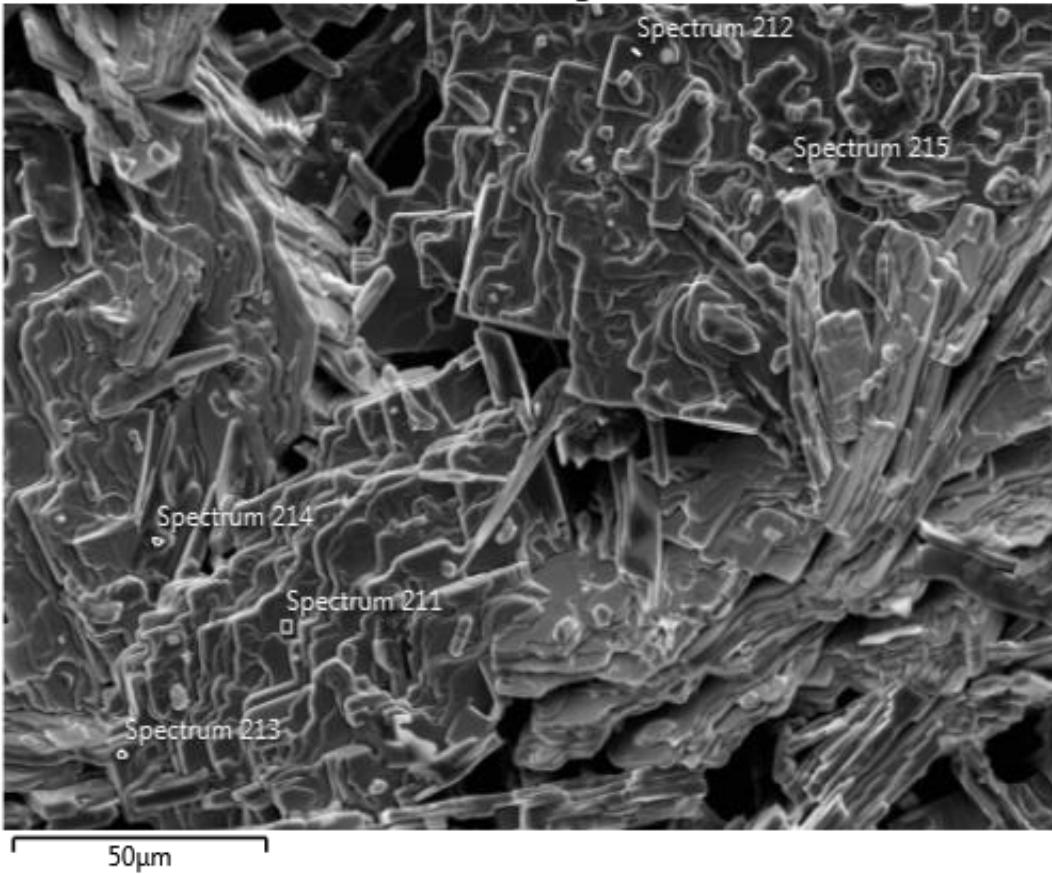


surface resistance

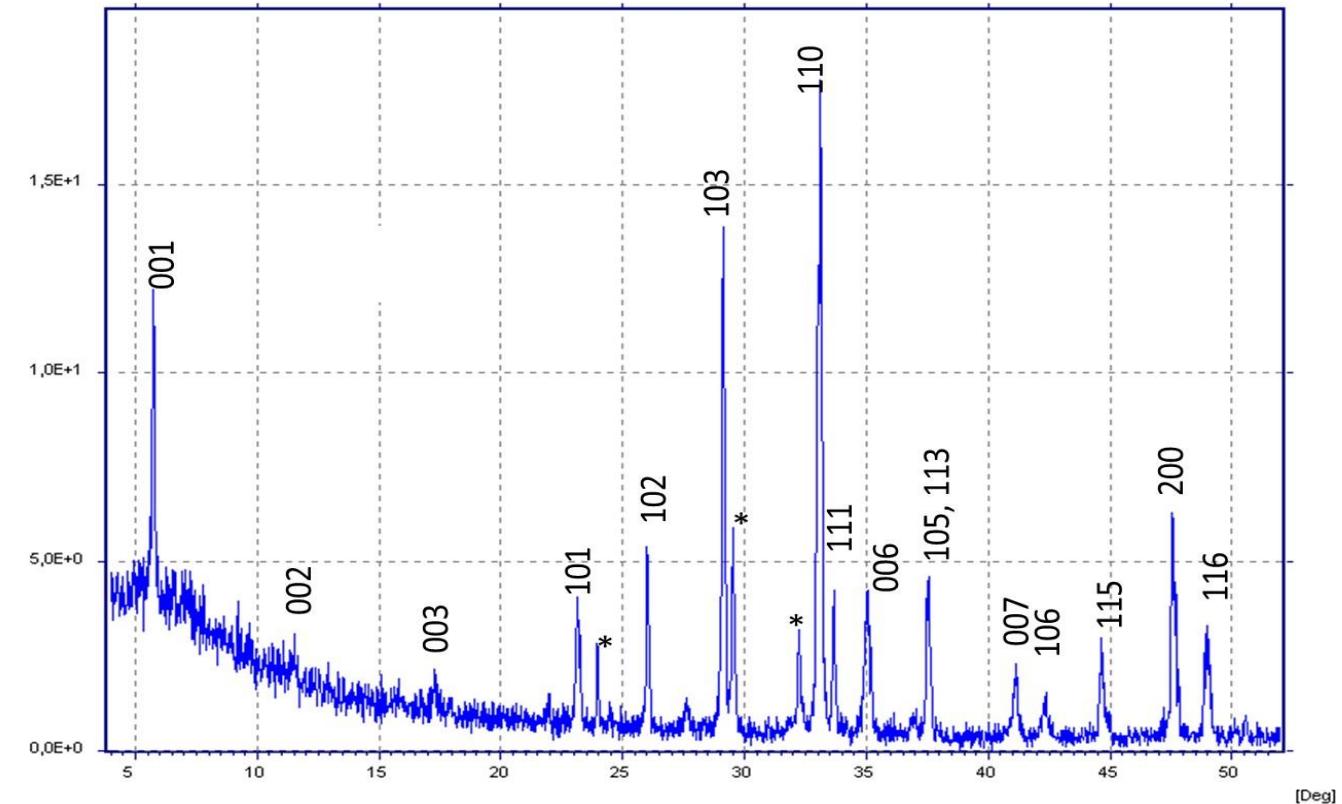


Pellet: Synthesis and results

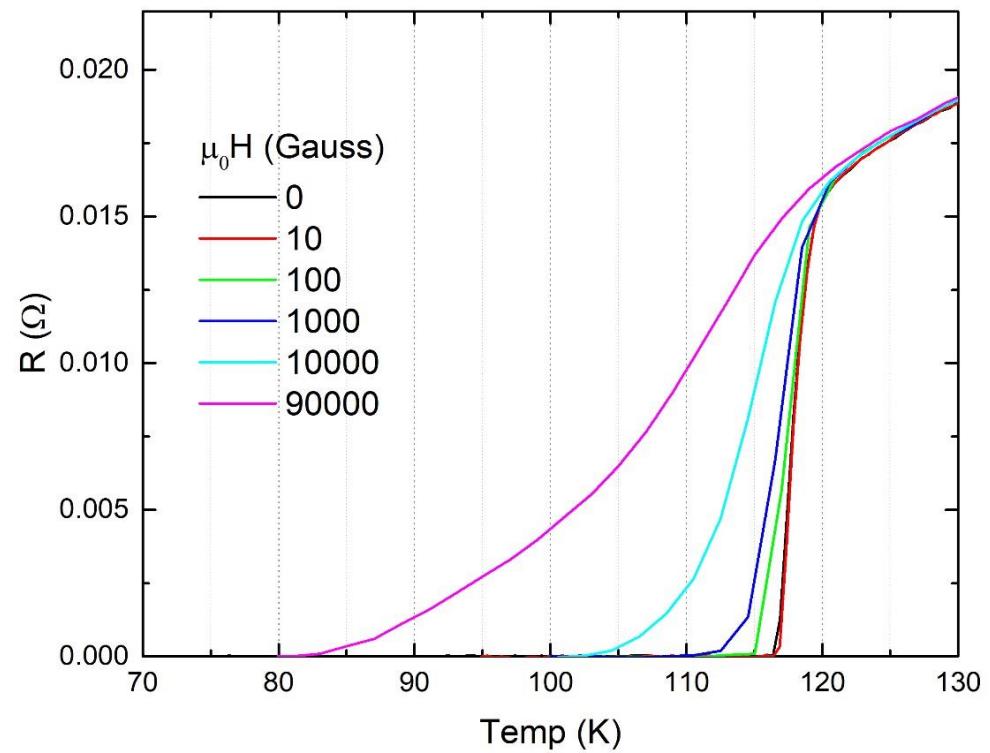
Electron Image 220



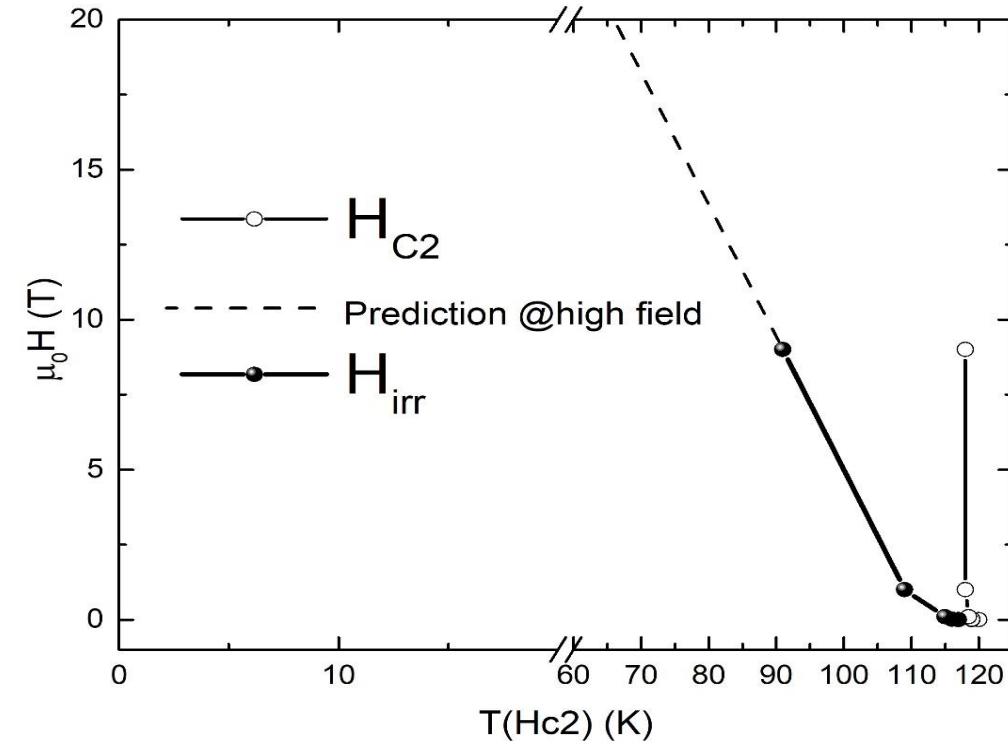
Big grains containing 1223 phase



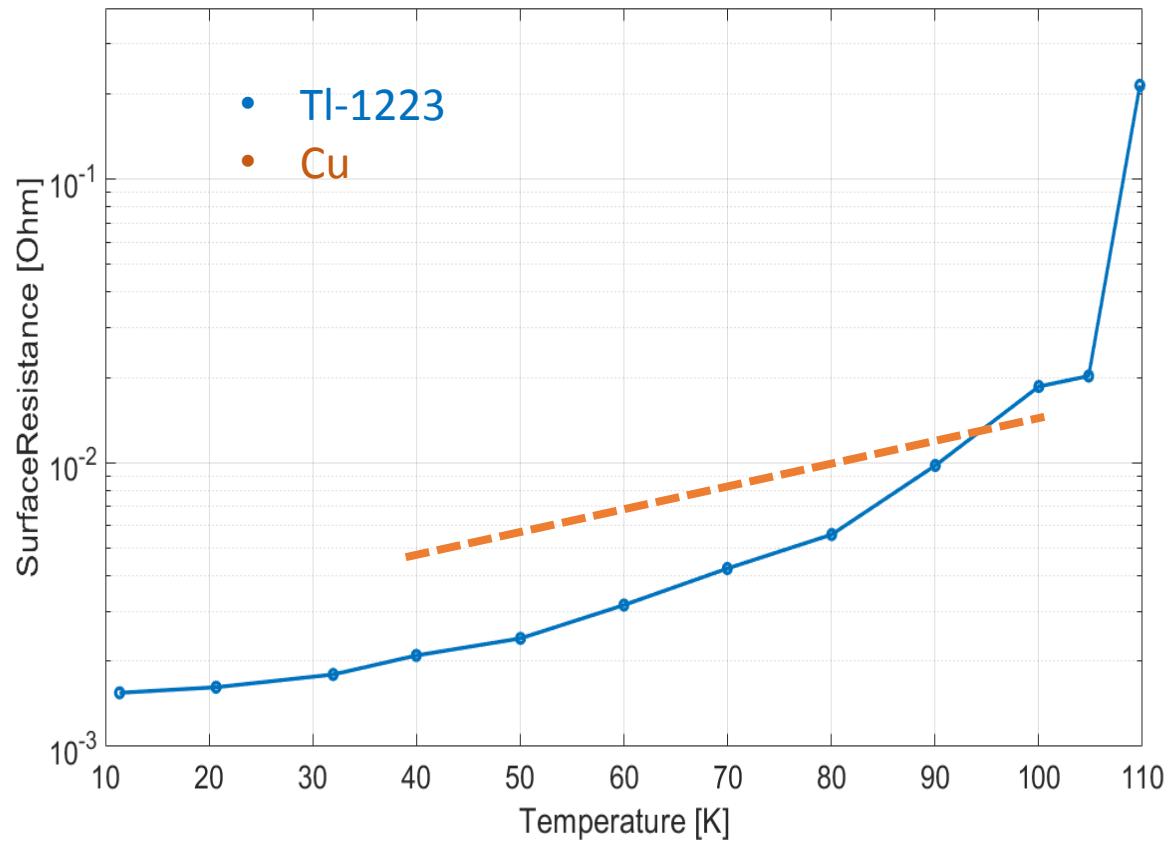
XRD pattern shows the phase (1223) is almost pure. * is Tl(1212) phase.



$R(T)$ measures The pellet has T_c (onset) 118K

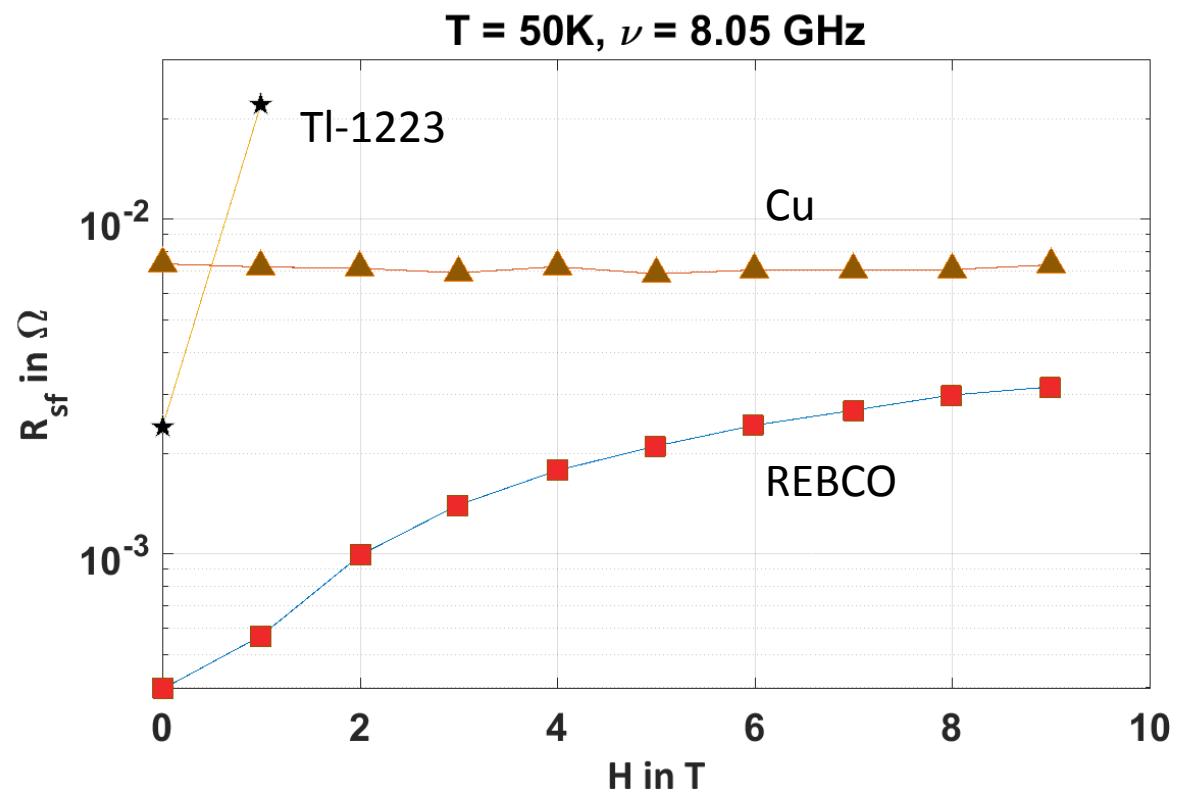


High frequency surface resistance (8.05 GHz)



P. Krkotic (ALBA synchrotron)

Surface resistance Jc measurements of the bulk sample

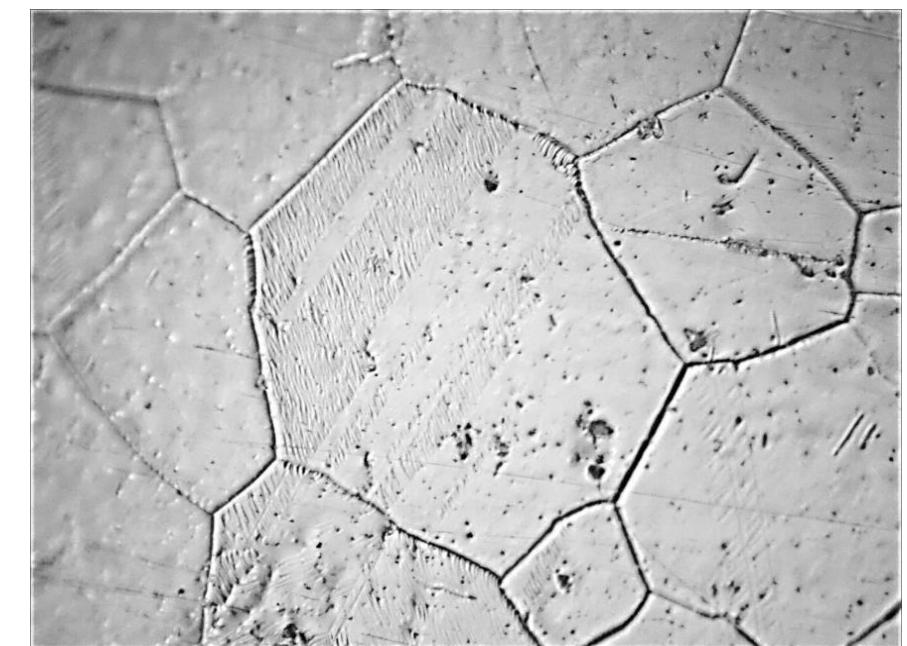


Preparation of the Substrates

8mm rod

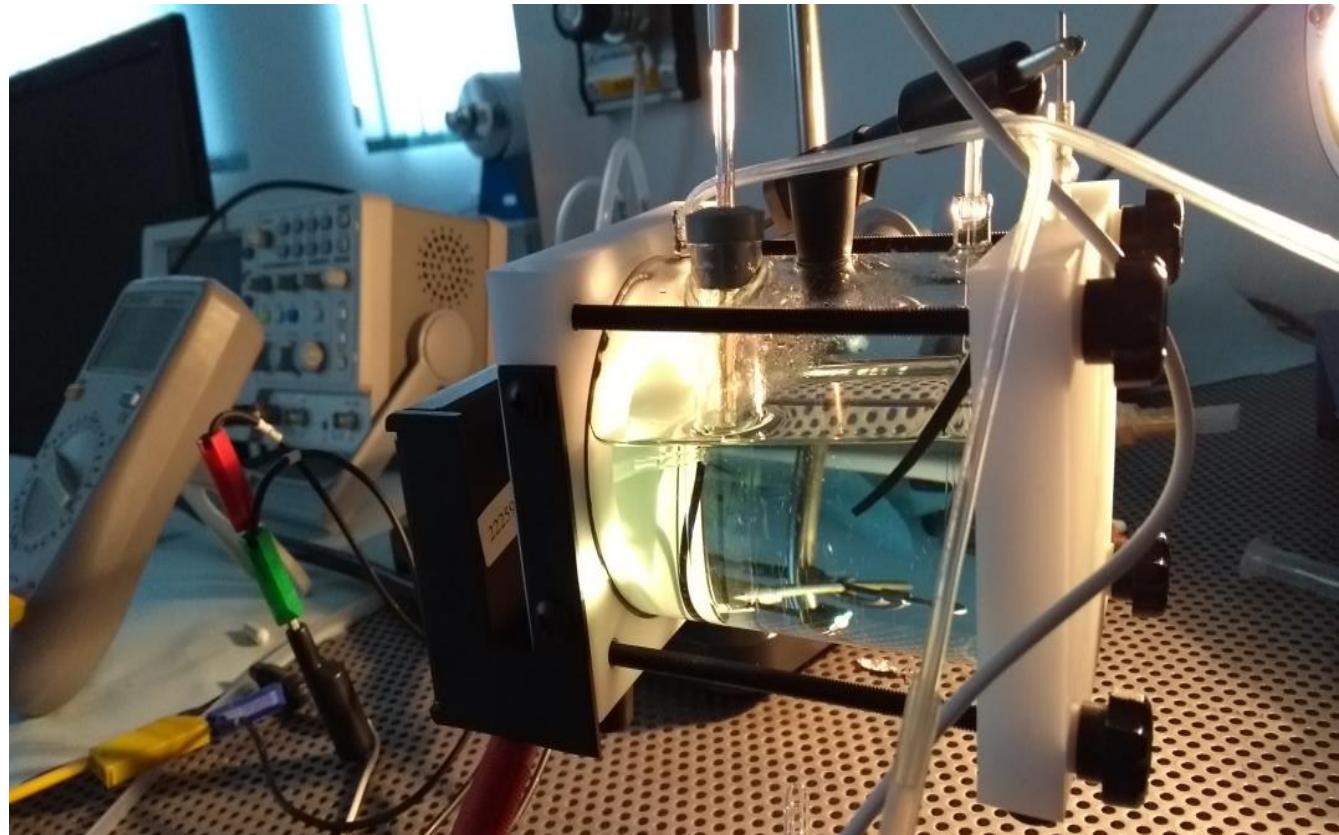


50 μ m, 100 μ m, 130 μ m, Ag-substrate



Surface after heat treatment

Methods for depositing the thin film Precursors



Solution:
Tl, Pb, Bi ,Sr, Ba,
Ca, Cu nitrates in
DMSO

Substrates:
Silver foils, single
crystal, SrTiO₃

electrodeposition
For 10 min, -2.9 to -3.1v

Final sintering in oxygen at high
temperature

Thallination of the thin film

Precursor film+Tl₂O₃ powder in gold capsule

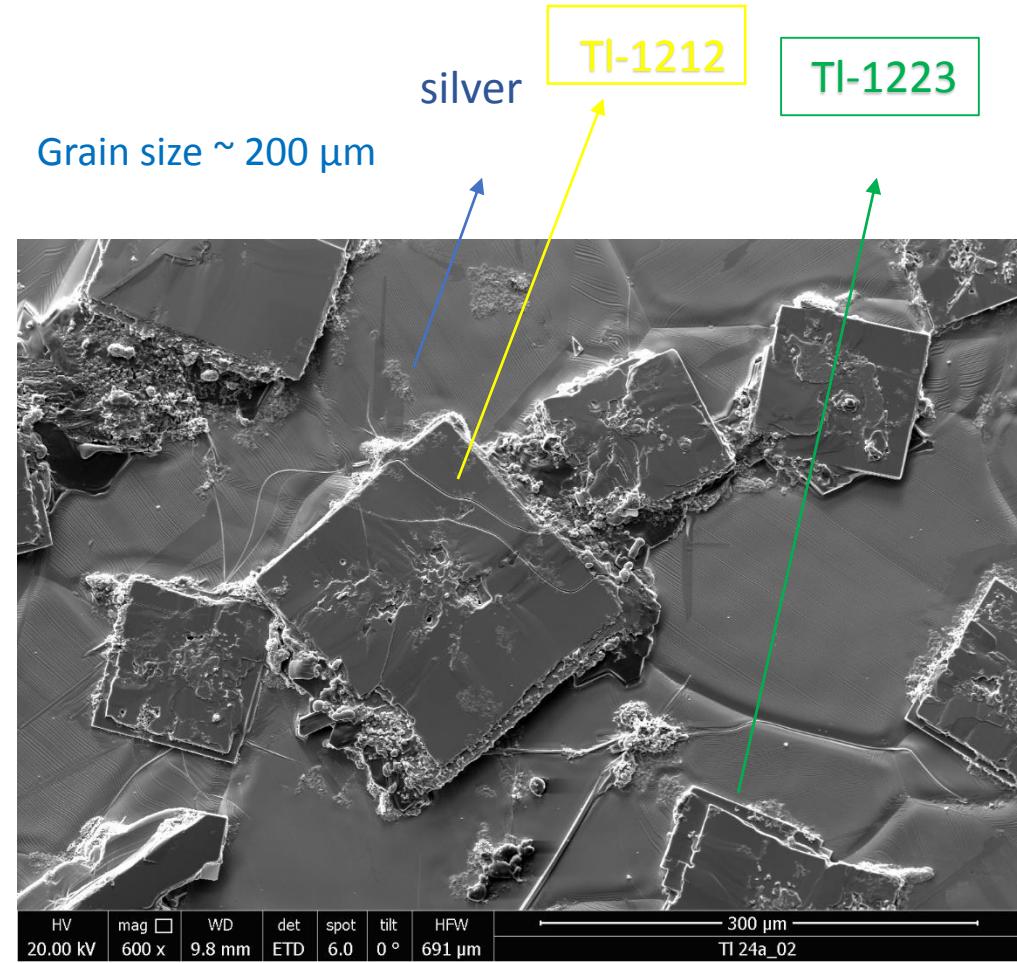
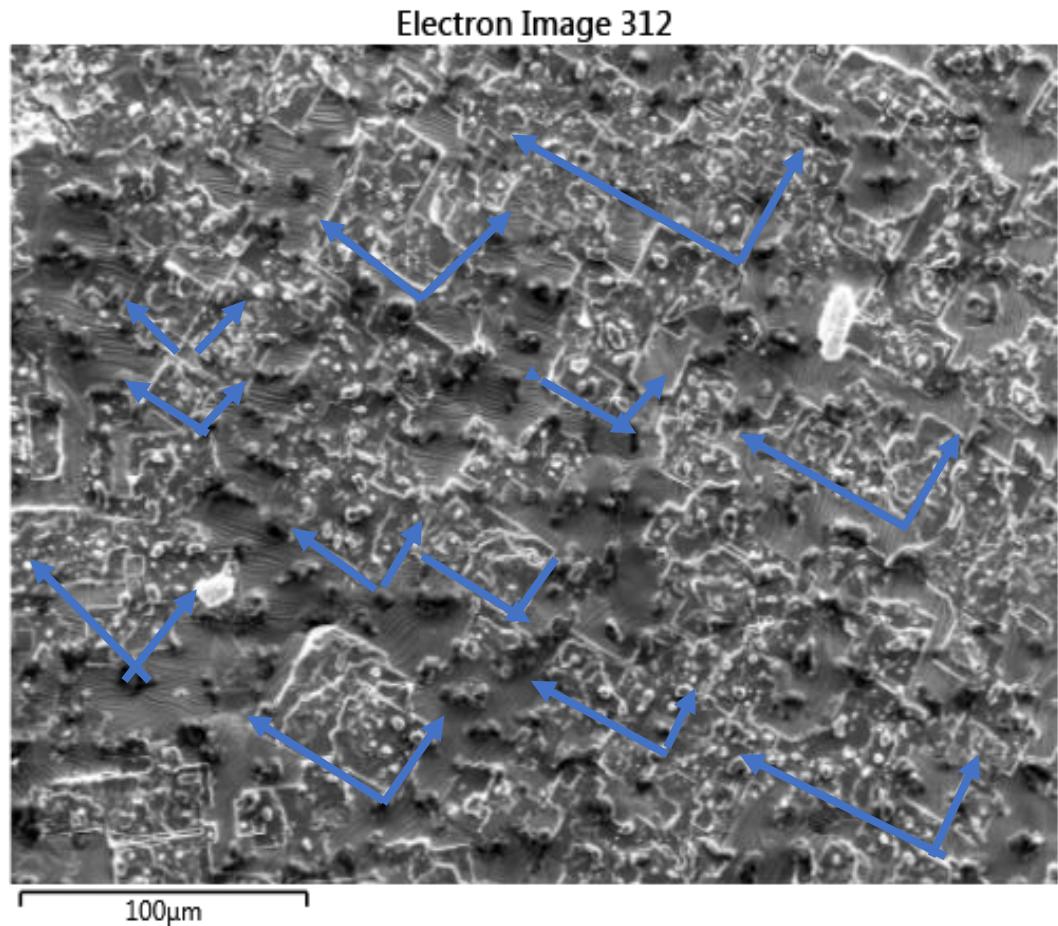


**Thallium Oxide
Powder**

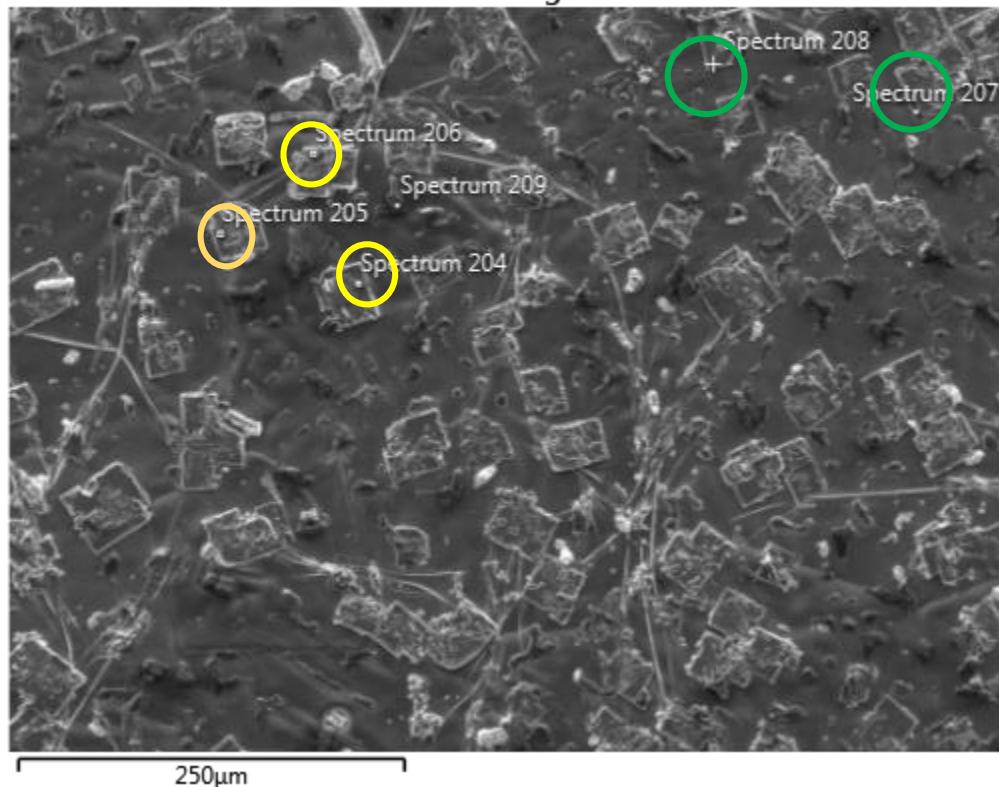
Thallium is volatile and Toxic in nature



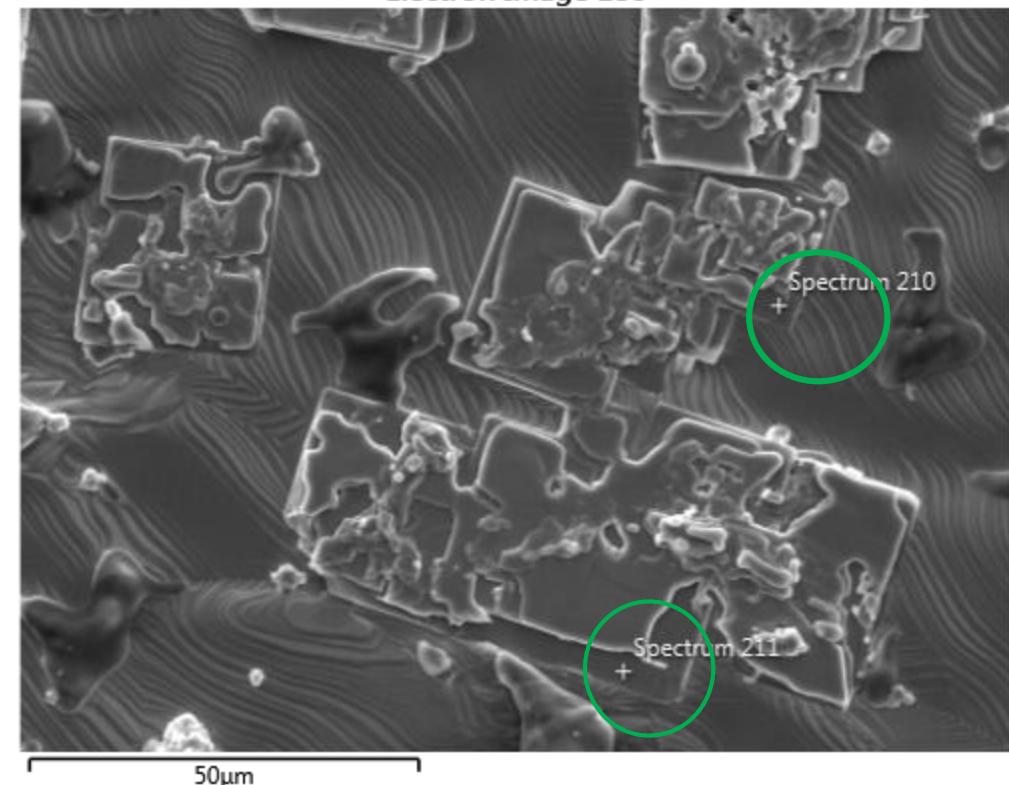
Thin film on Silver Substrate



Electron Image 184



Electron Image 186



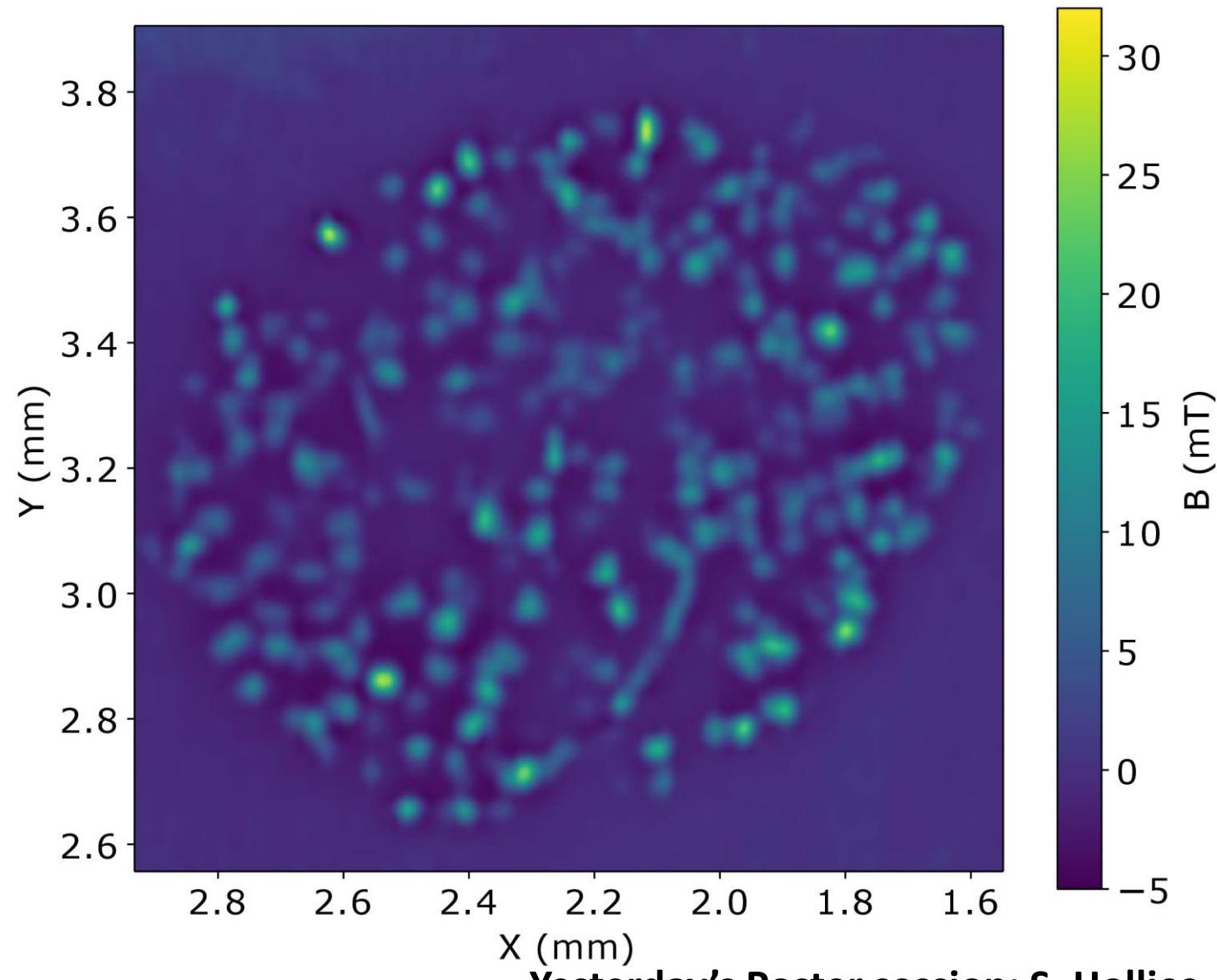
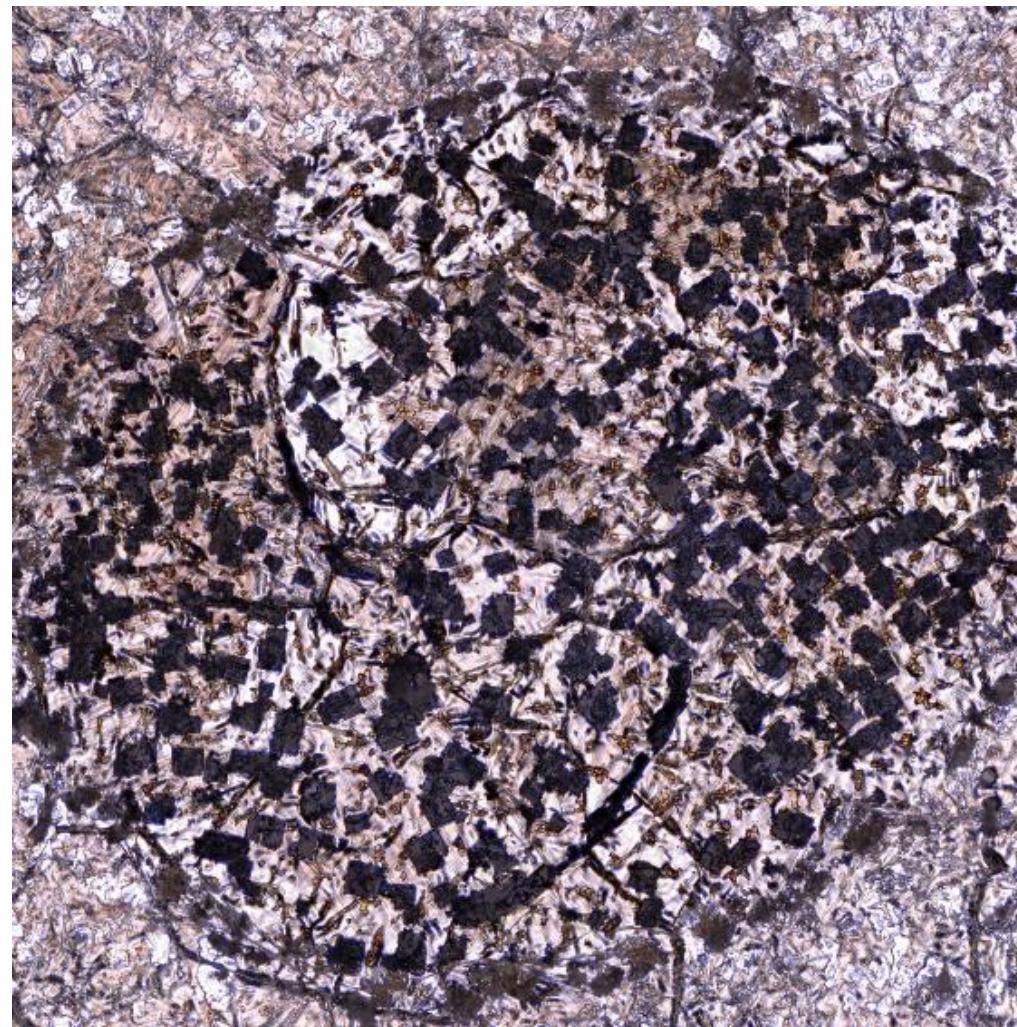
Quant Results View

Viewed Data: Multiple Spectra

Result Type:

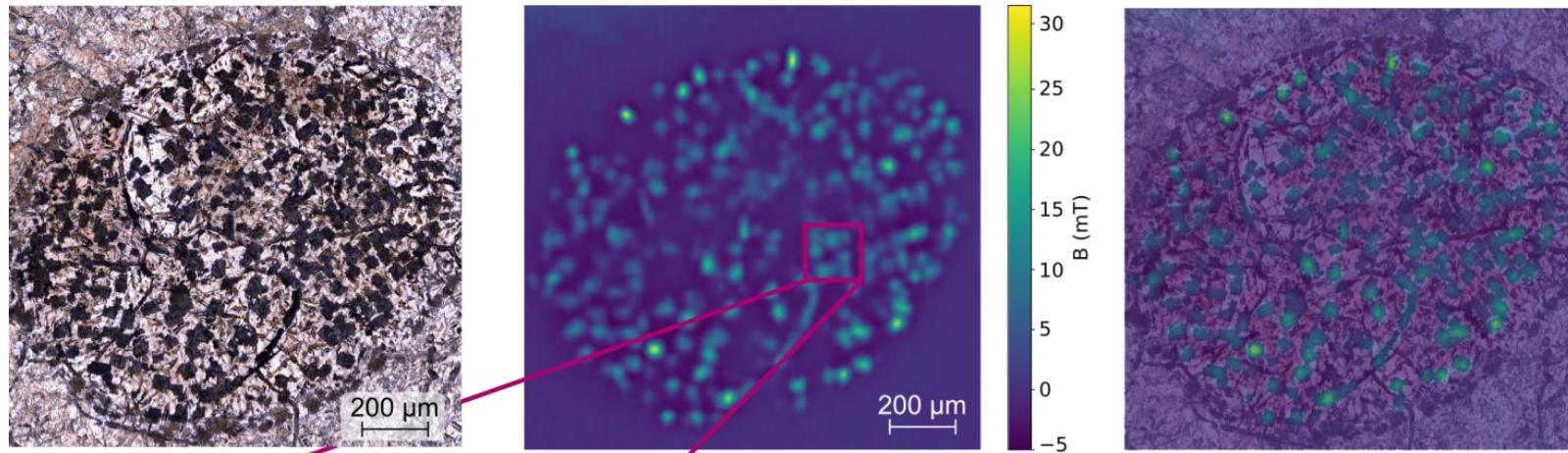
Spectrum Label	O	Ca	Cu	Sr	Ag	Ba	Tl	Pb	Bi	Total
Spectrum 204	57.99	7.03	12.56	12.57	0.06	1.30	5.87	0.72	1.90	100.00
Spectrum 205	54.13	7.03	15.97	13.83	0.38	0.92	5.35	1.60	0.79	100.00
Spectrum 206	56.07	7.08	13.94	13.47	0.04	1.06	5.81	1.67	0.86	100.00
Spectrum 207	62.35	9.16	11.42	7.93	2.37	1.04	3.53	1.41	0.79	100.00
Spectrum 208	59.15	9.89	11.76	7.46	5.59	0.92	3.32	1.17	0.73	100.00
Spectrum 209	45.21	43.25	0.24	0.59	5.54	0.00	4.82	0.19	0.15	100.00
Spectrum 210	43.94	14.11	17.49	8.52	9.37	0.48	3.52	1.54	1.05	100.00
Spectrum 211	55.58	10.36	12.46	7.23	8.57	0.88	3.00	1.23	0.69	100.00

Current flow analysis of Tl-1223 Superconductors by Scanning Hall Probe Microscopy

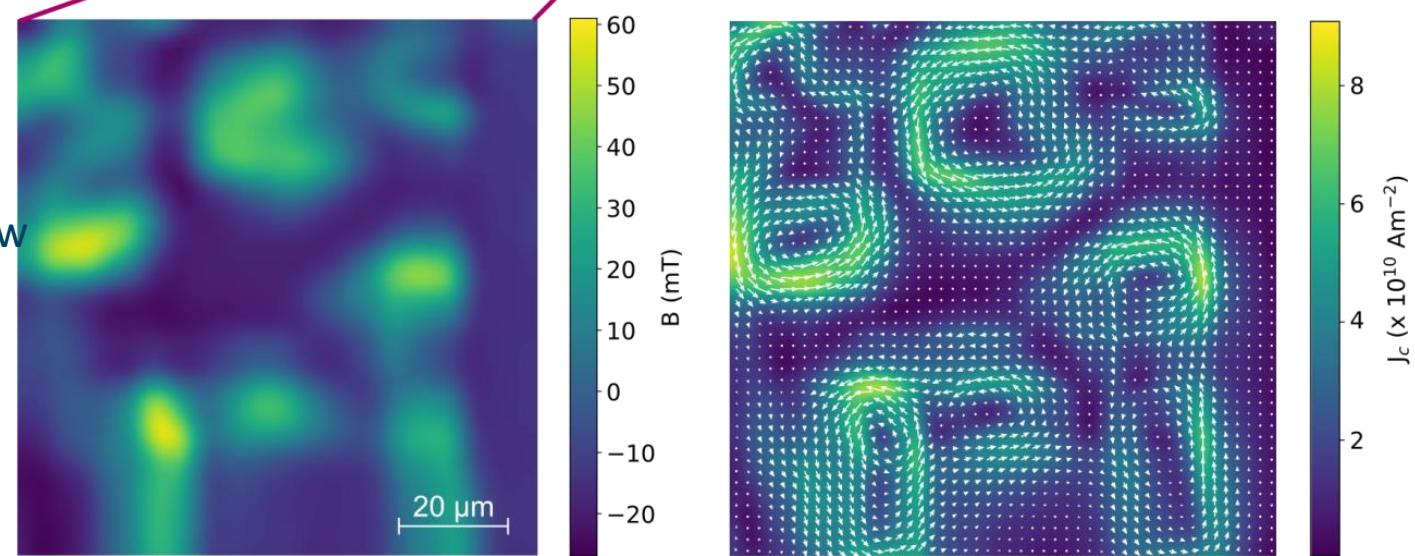


Yesterday's Poster session: S. Hollies

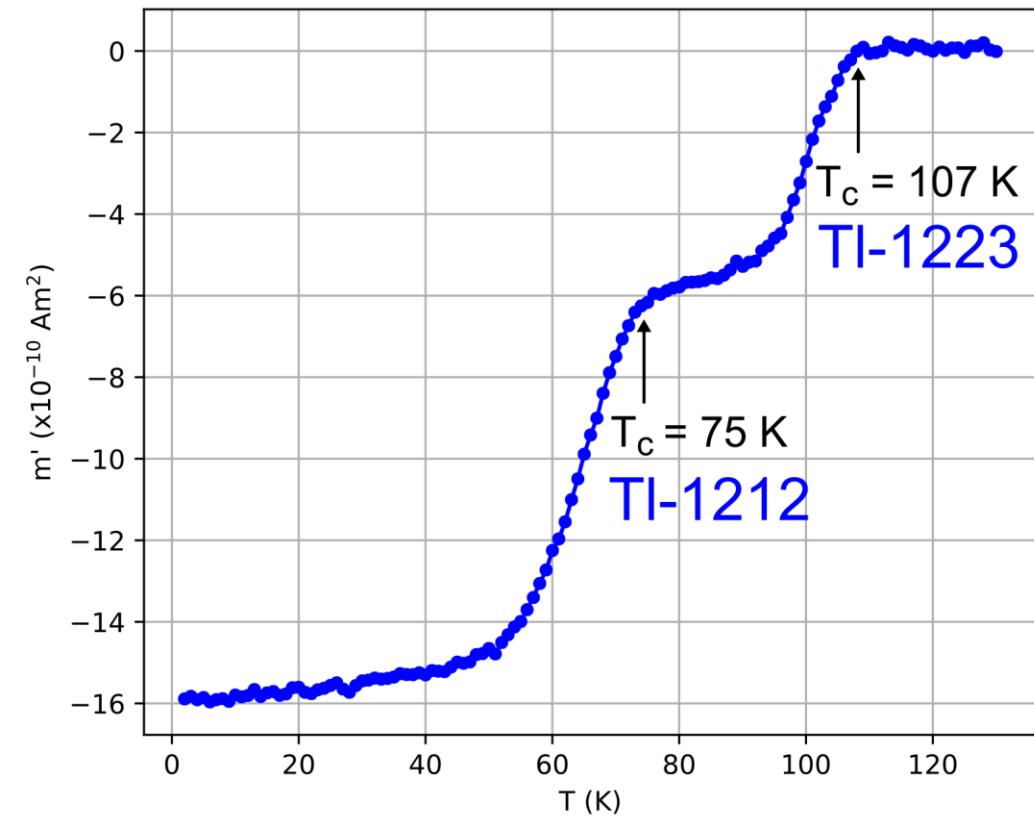
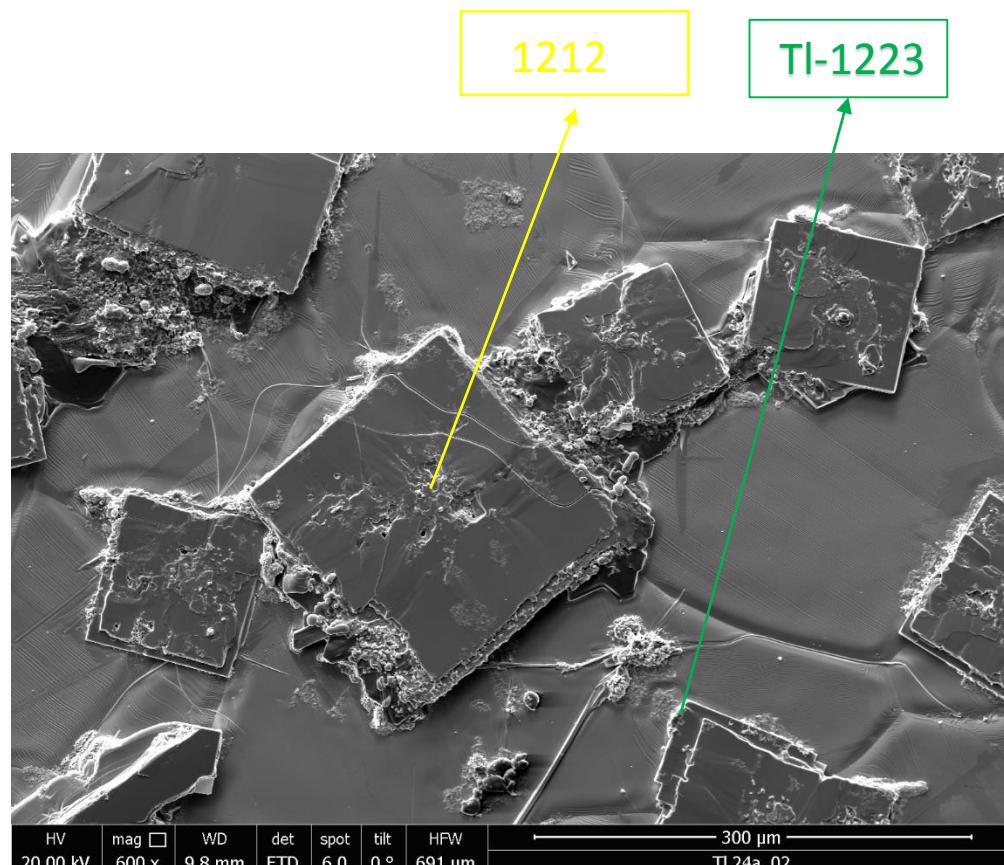
- TI-1223 grains (30-50 μm) on Ag substrate

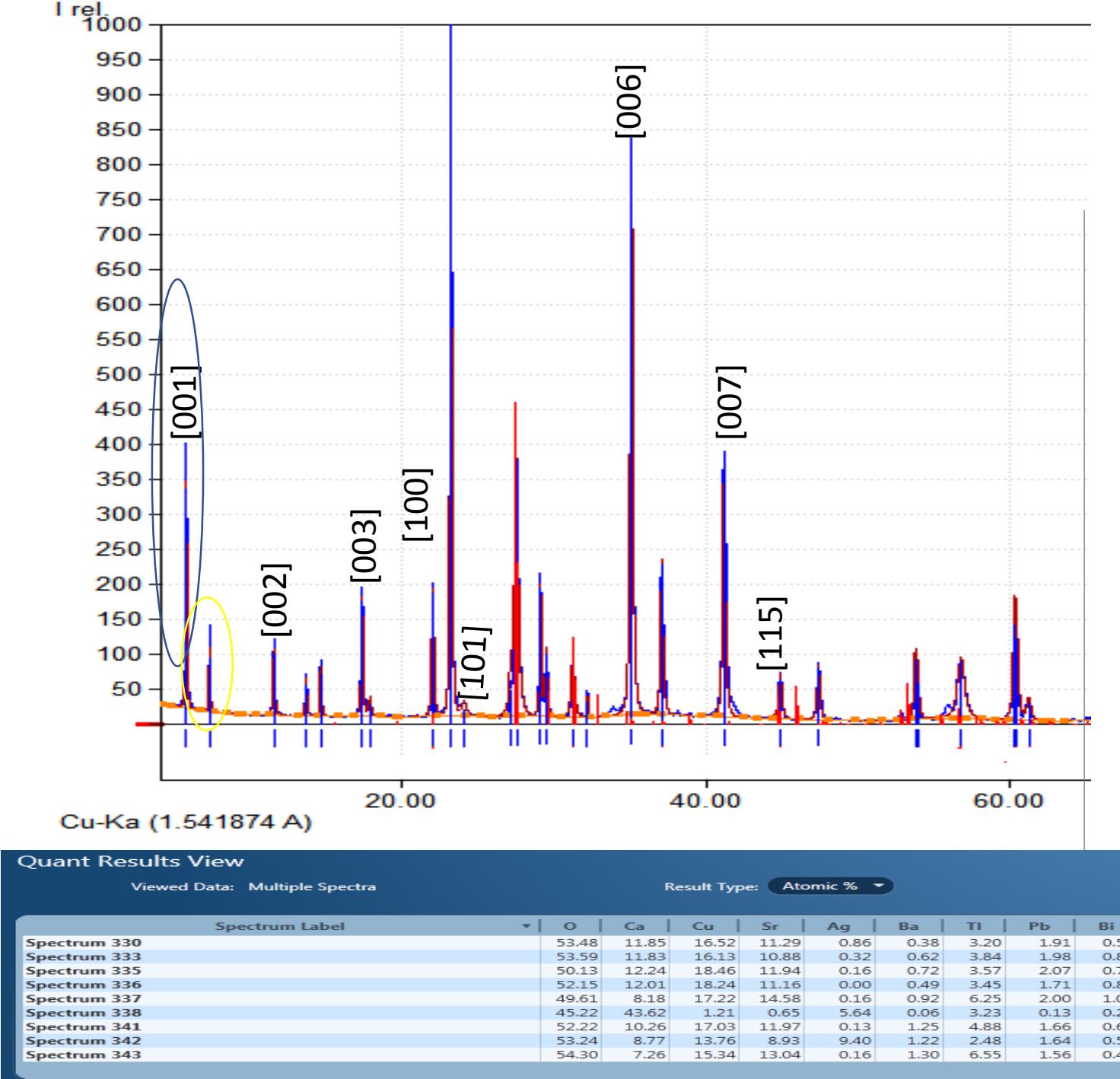
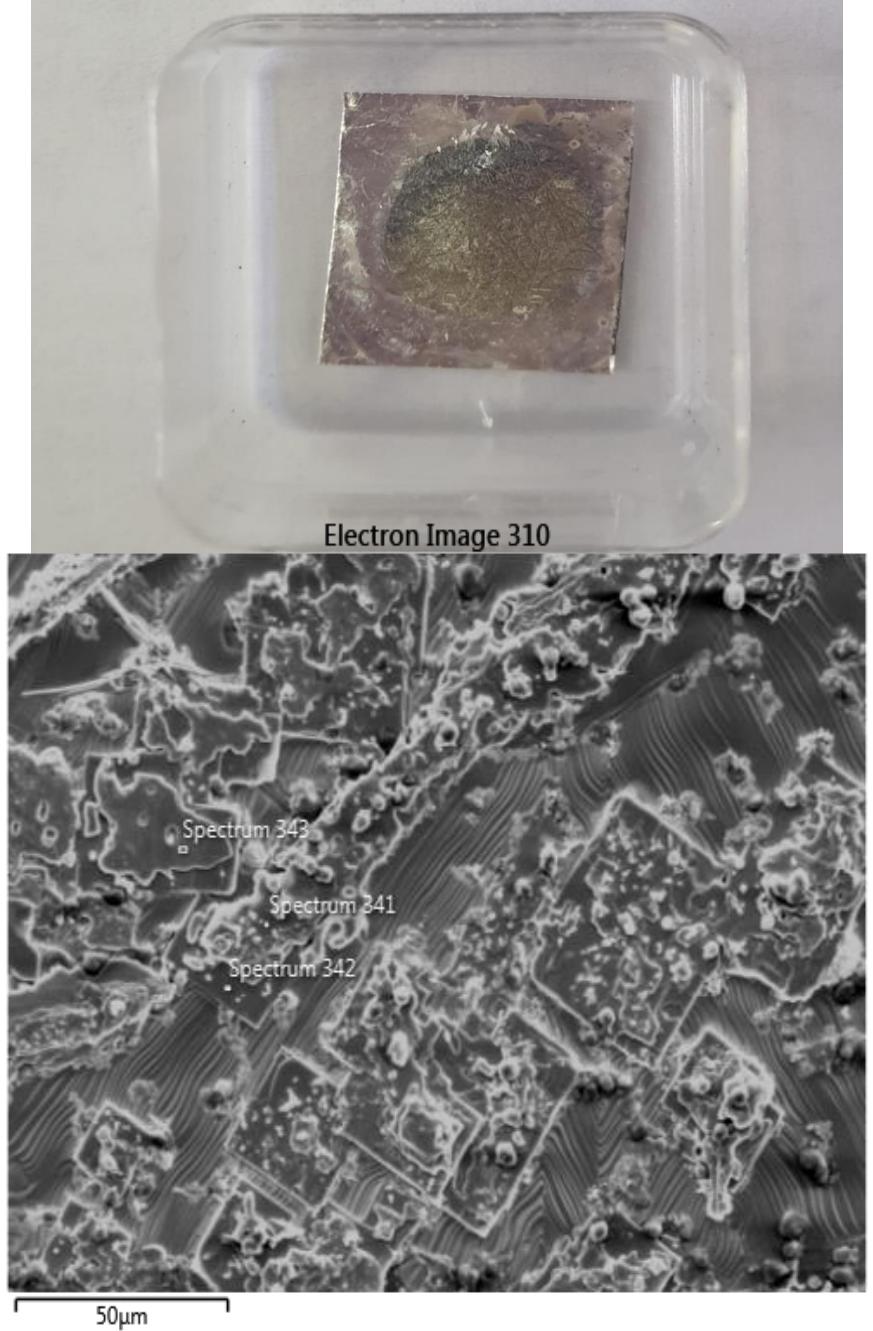


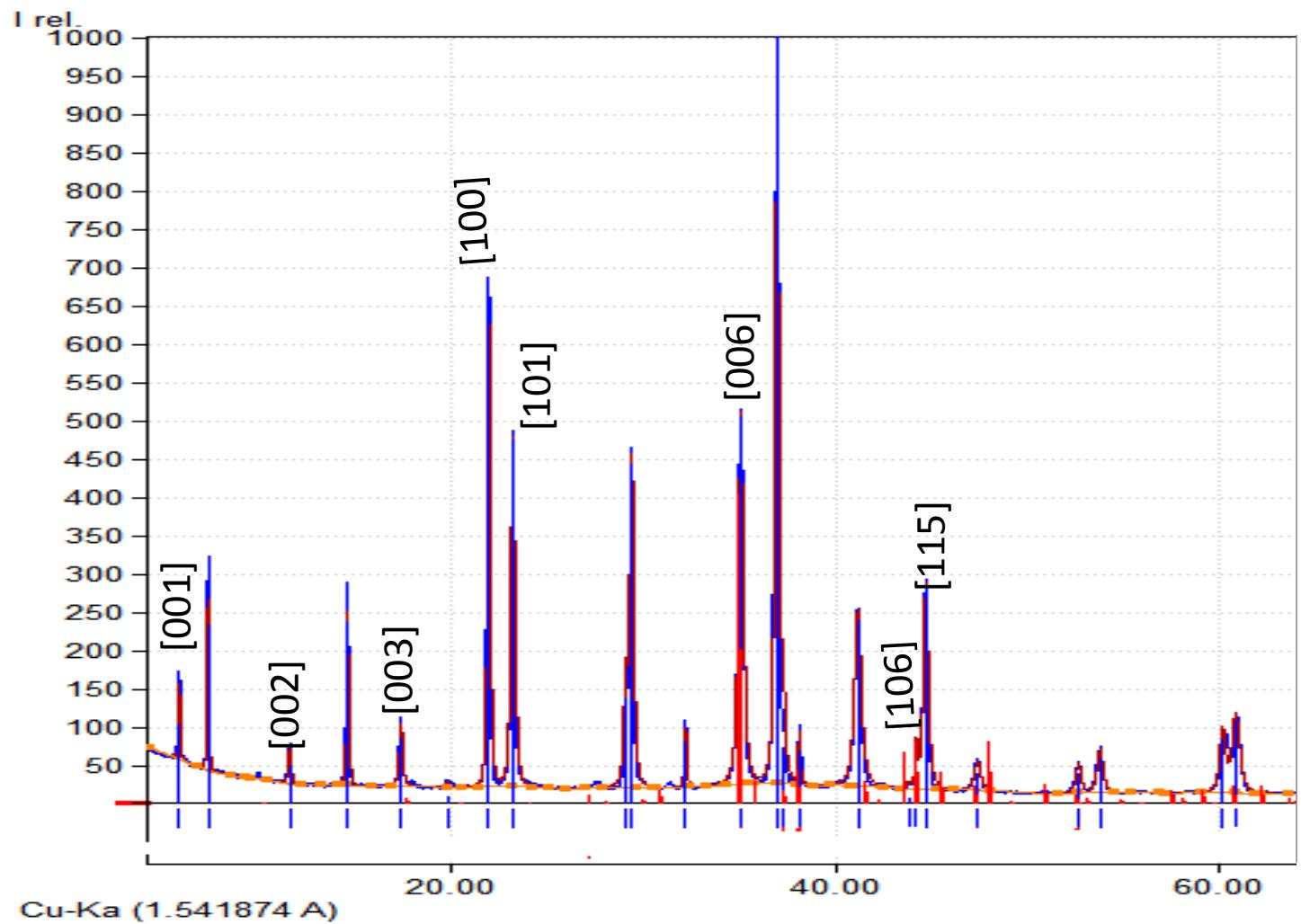
- Inversion of the remnant field shows current flow in grains and across grain boundaries



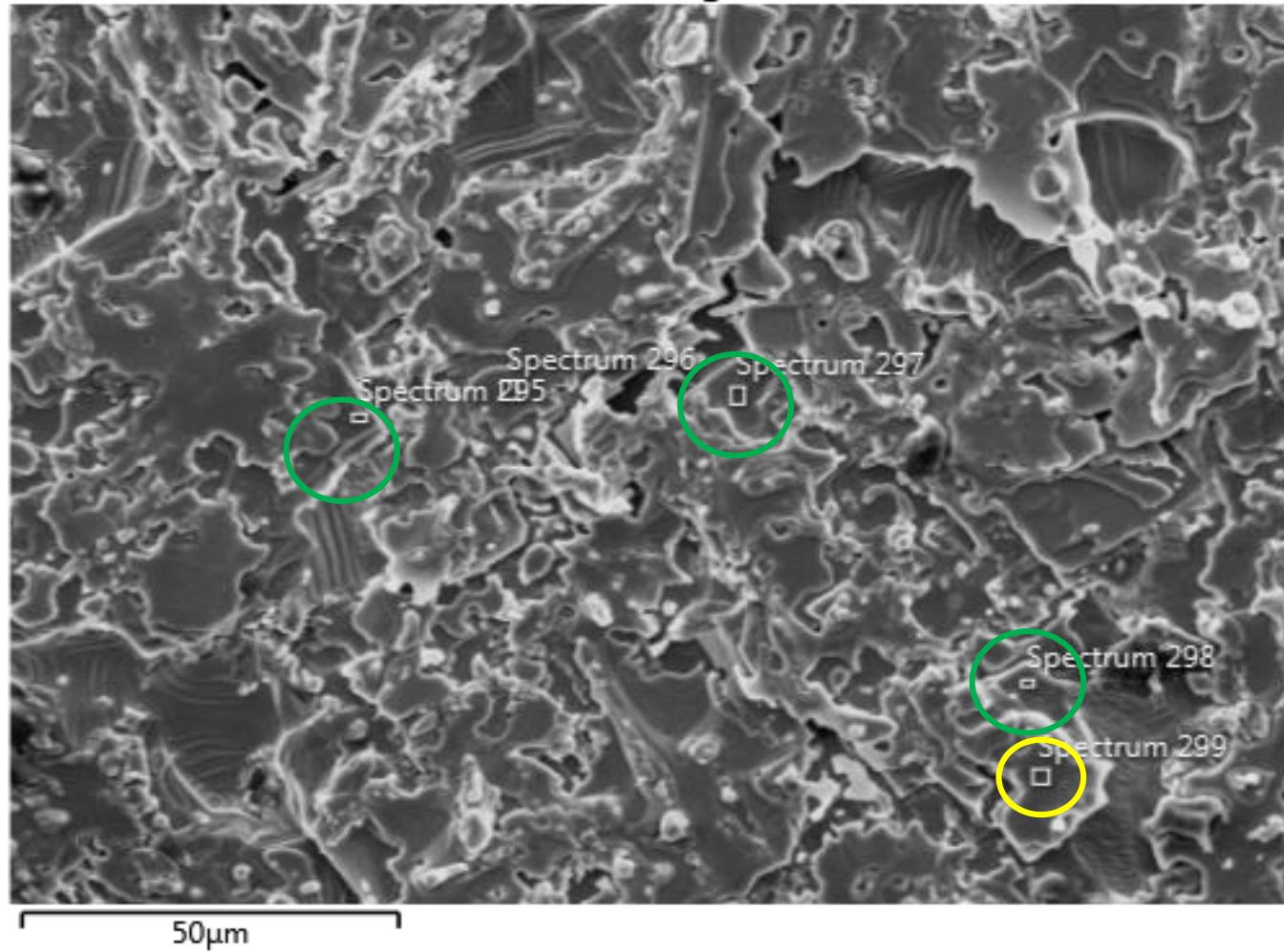
T_c measurement of the thallium film on silver substrate







Electron Image 276

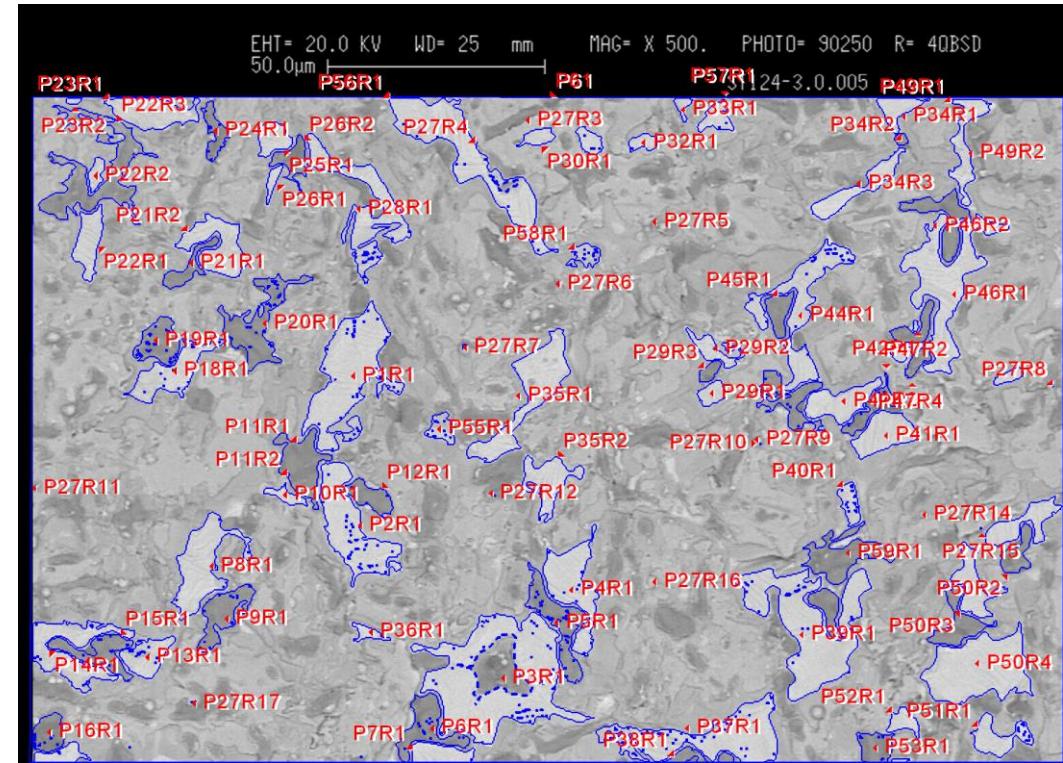
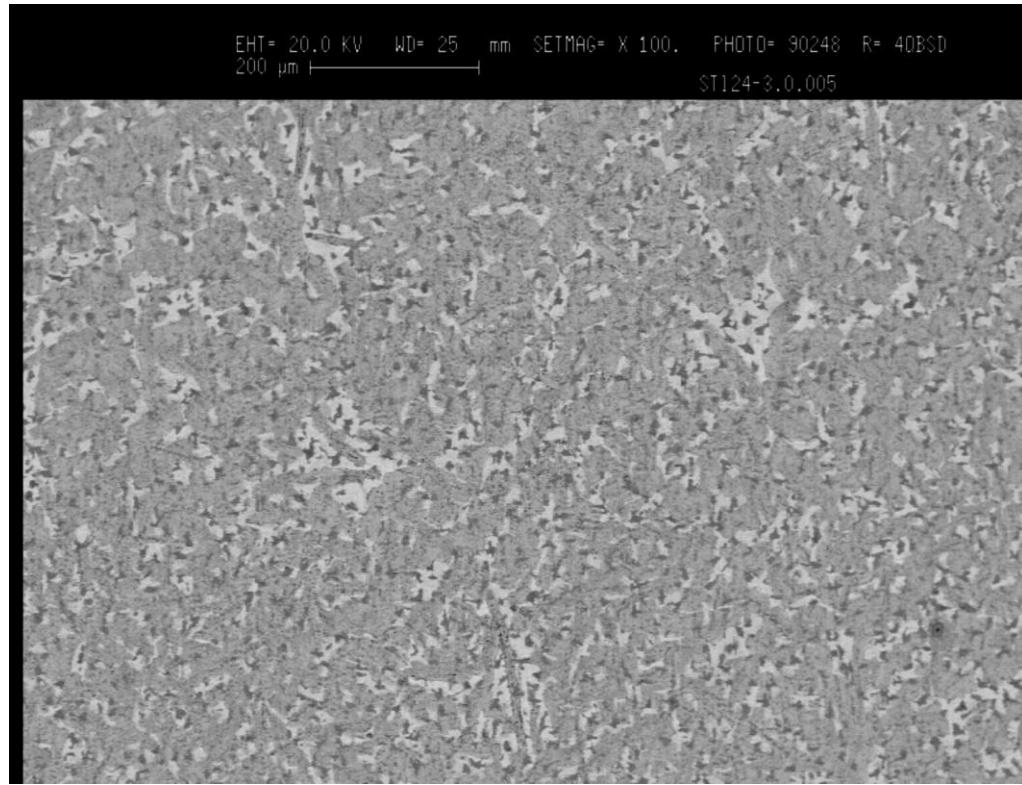


Quant Results View

Viewed Data: Multiple Spectra

Result Type:

Spectrum Label	O	Ca	Cu	Sr	Ag	Ba	Tl	Pb	Bi	Total
Spectrum 295	53.01	11.39	17.57	9.87	0.16	2.01	3.39	2.03	0.56	100.00
Spectrum 296	58.16	5.80	13.20	12.40	0.48	1.88	6.21	1.25	0.62	100.00
Spectrum 297	57.50	8.28	12.34	6.80	8.58	2.06	2.79	1.17	0.46	100.00
Spectrum 298	56.51	9.16	13.96	7.48	6.66	1.76	2.77	1.31	0.38	100.00
Spectrum 299	55.23	6.28	14.82	12.78	0.14	2.21	6.23	1.46	0.84	100.00



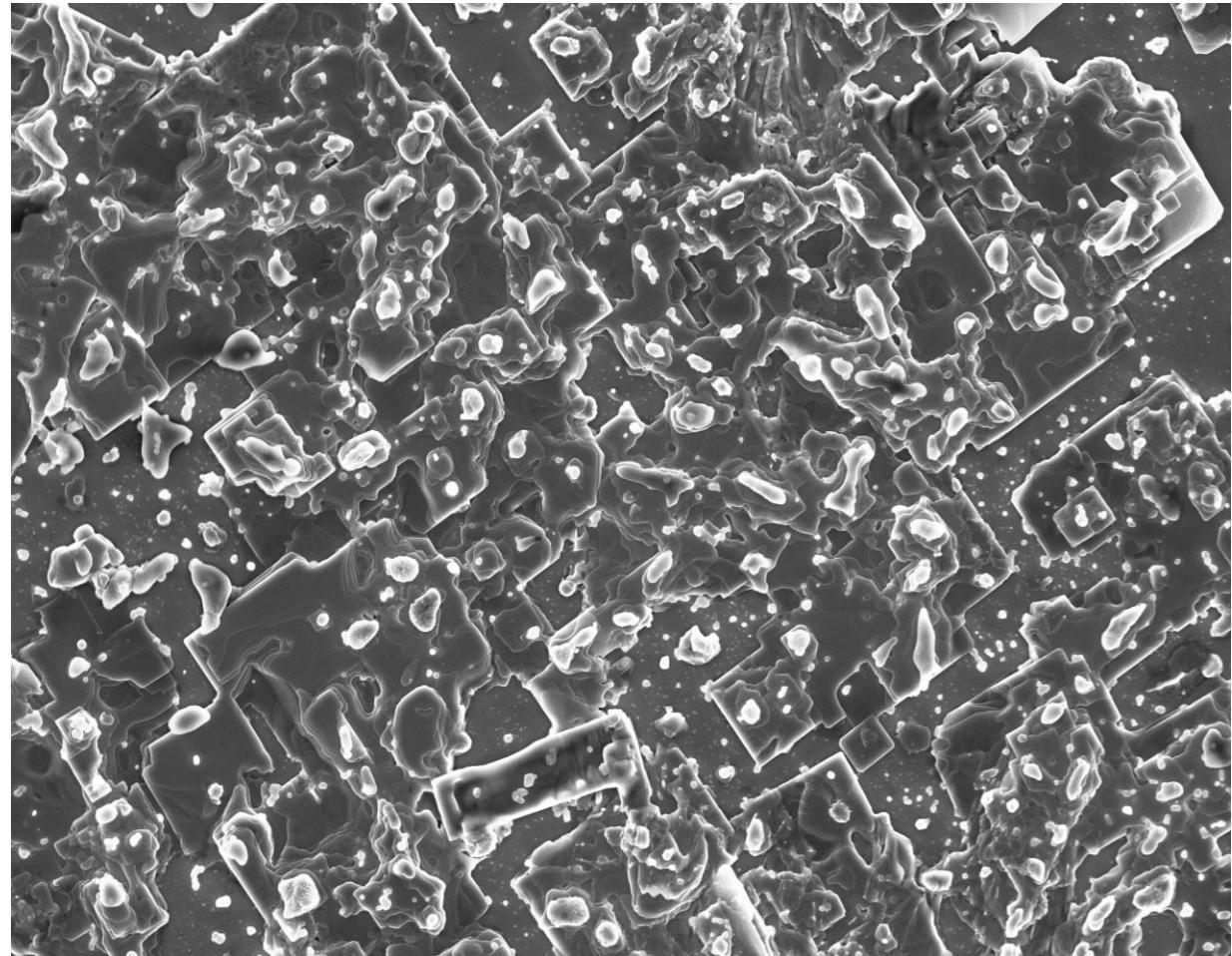
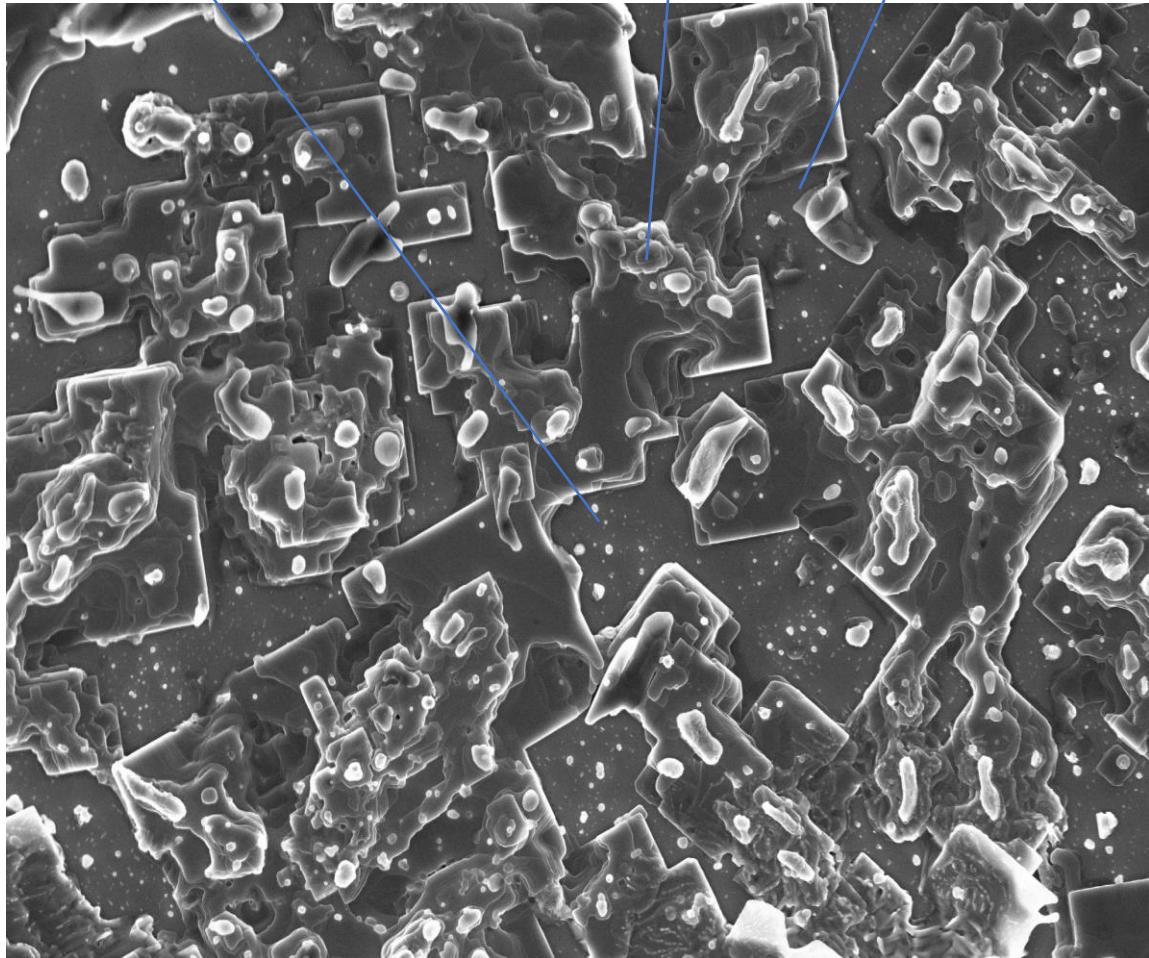
~80 % area is covered with crystals

Thin film on the SrTiO₃ substrate

Silver

Ca-O

Tl-1223



- Different substrates
- Better coverage of the thin film
- Textured thin films
- Purification of the 1223 phase



EASITrain



Thank You



CNR-SPIN, Genova, Italy