Sekcja Metod Badań Materiałów Komitetu Nauki o Materiałach PAN
oraz
Instytut Metalurgii i Inżynierii Materiałowej PAN

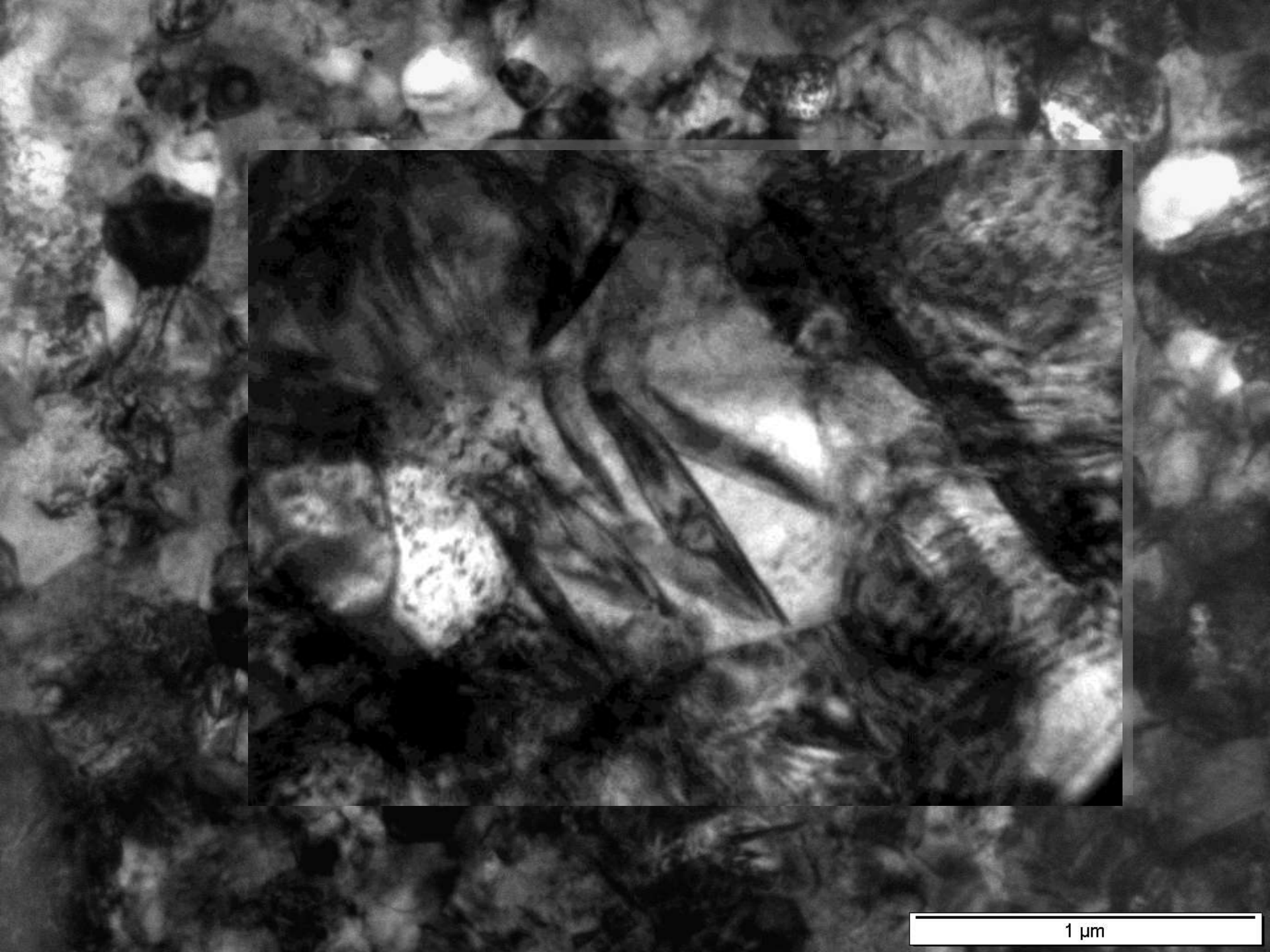
Characterization of nano-materials with advanced transmission electron microscopy techniques

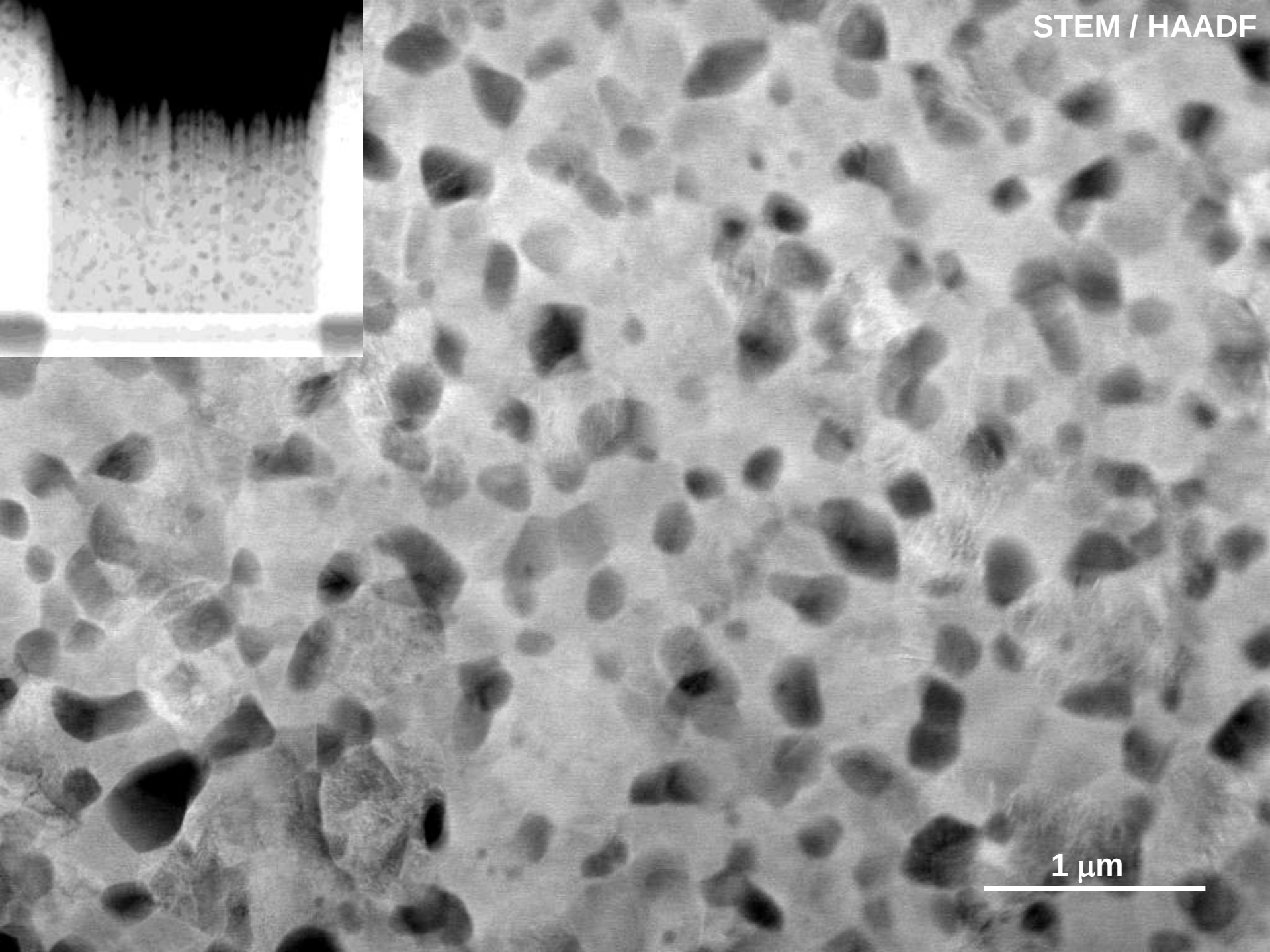
TEM LAB

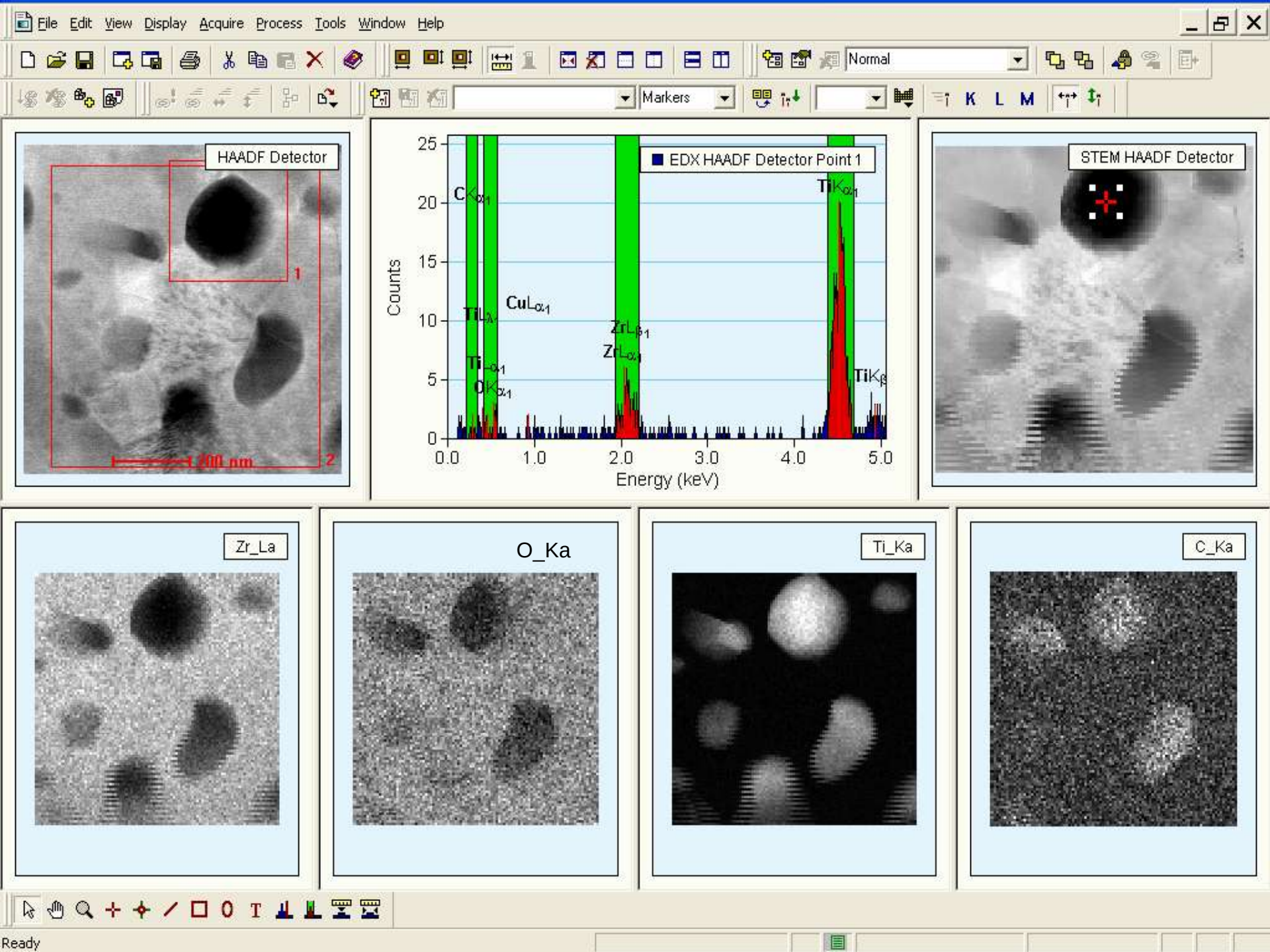
Jerzy Morgiel

Compacts of YTZP / TiC

1500^{o}C / 10^{-4}mbara / 2 hrs.


1 µm


STEM / HAADF
1 μm

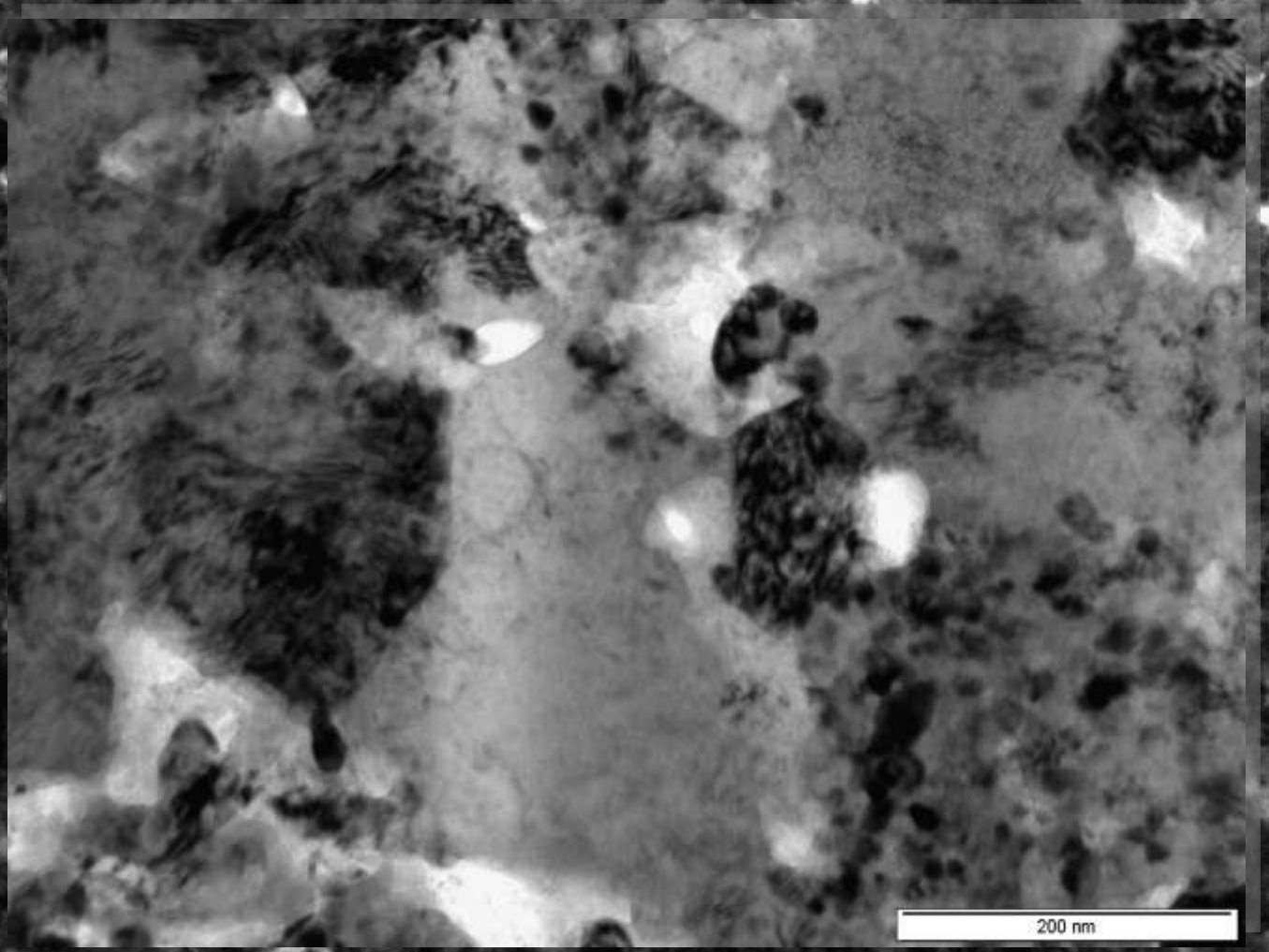

File Edit View Display Acquire Process Tools Window Help
Normal
Markers
K L M
HAADF Detector
1
2
200 nm
EDX HAADF Detector Point 1
Counts
Energy (keV)
0.0
1.0
2.0
3.0
4.0
5.0
0
5
10
15
20
25
CKα1
TiLα1
CuLα1
TiLα1
OKα1
ZrLβ1
ZrLα1
TiKα1
TiKβ
STEM HAADF Detector
Zr_La
O_Ka
Ti_Ka
C_Ka
Ready

Compacts YTZP / TiC

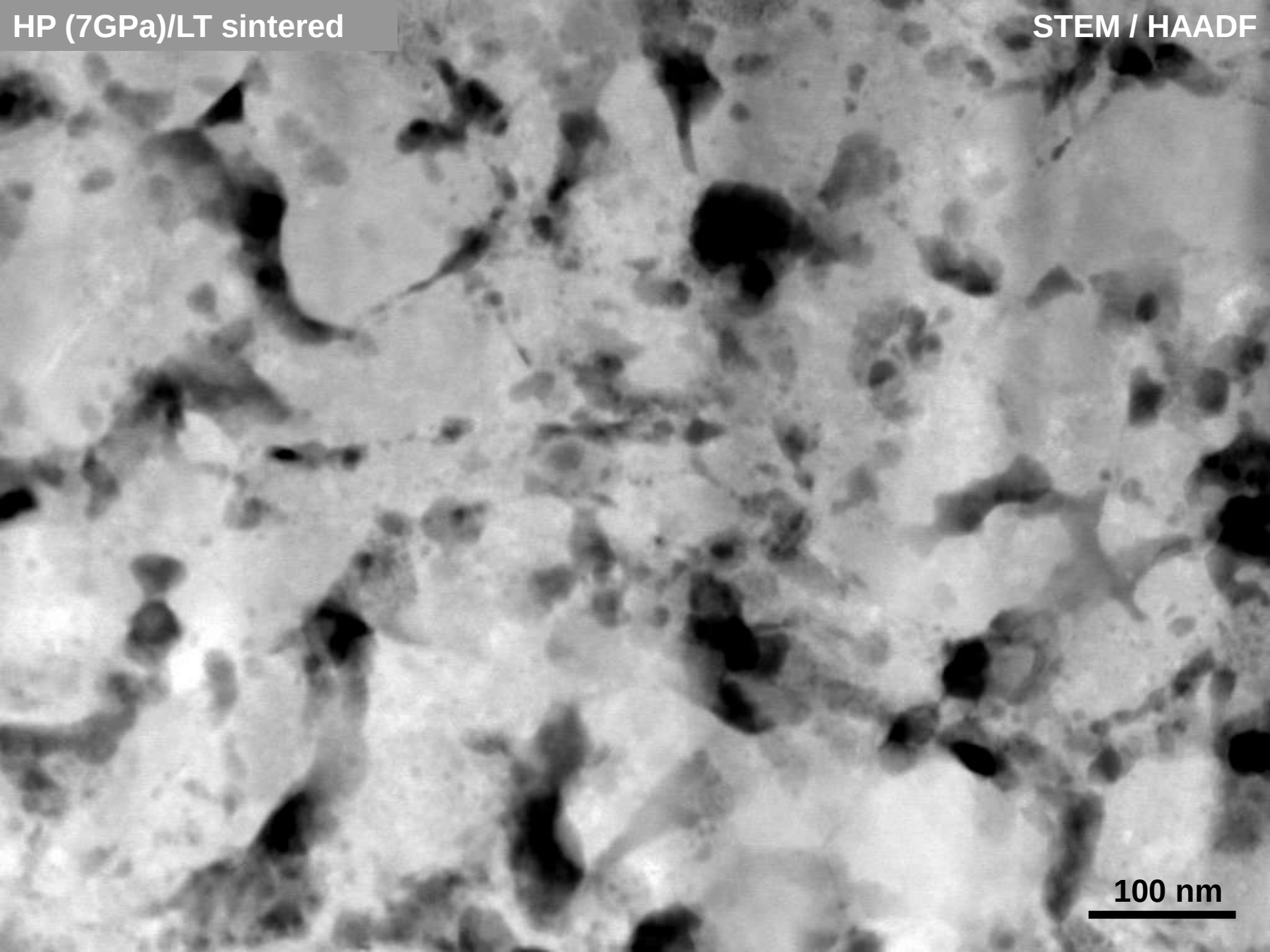
1250°C / 7,7 GPa / 30 sek

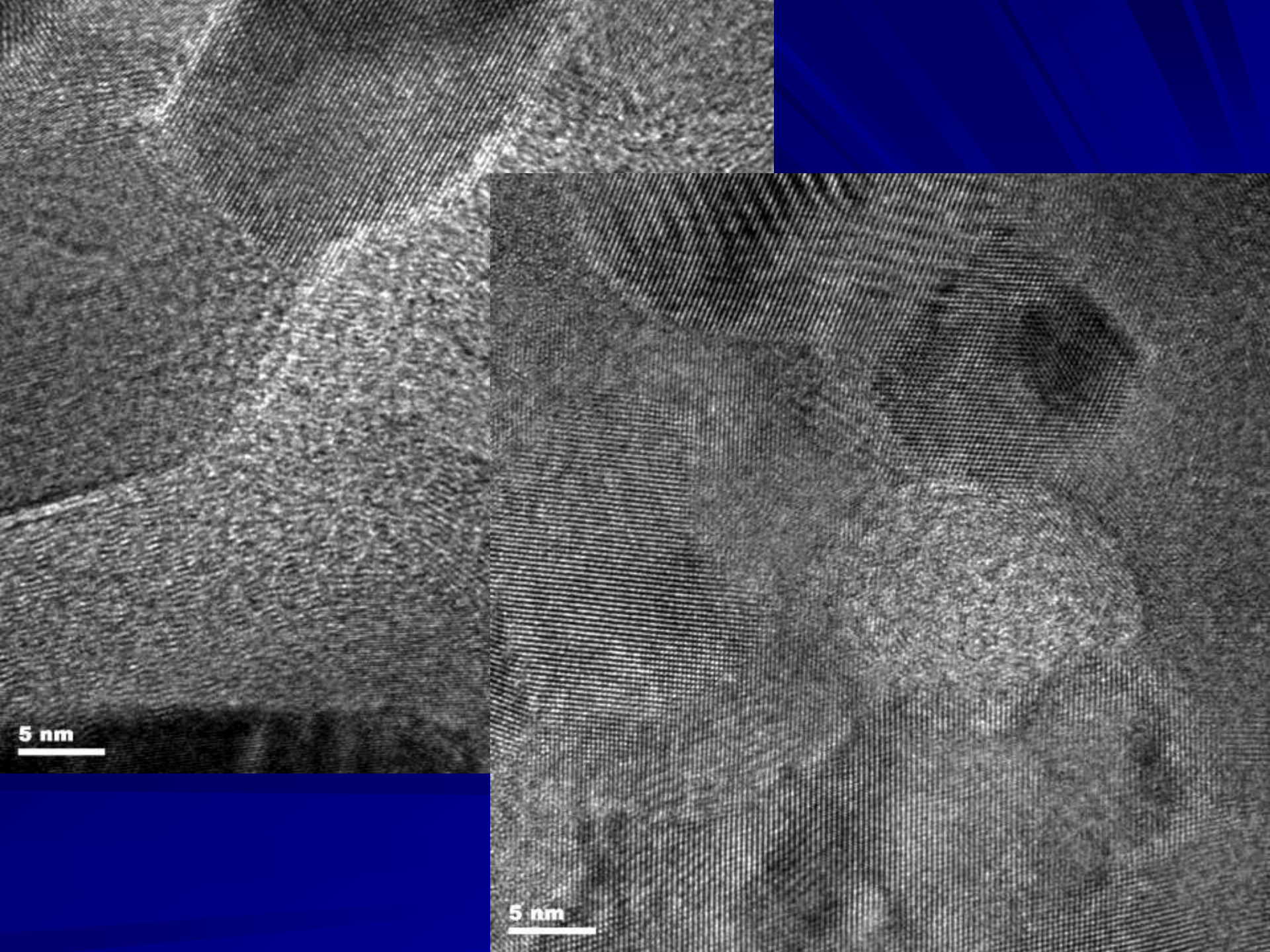
Waldemar Pyda, AGH,
Lucyna Jaworska, IOS

HP (7GPa)/LT sintering

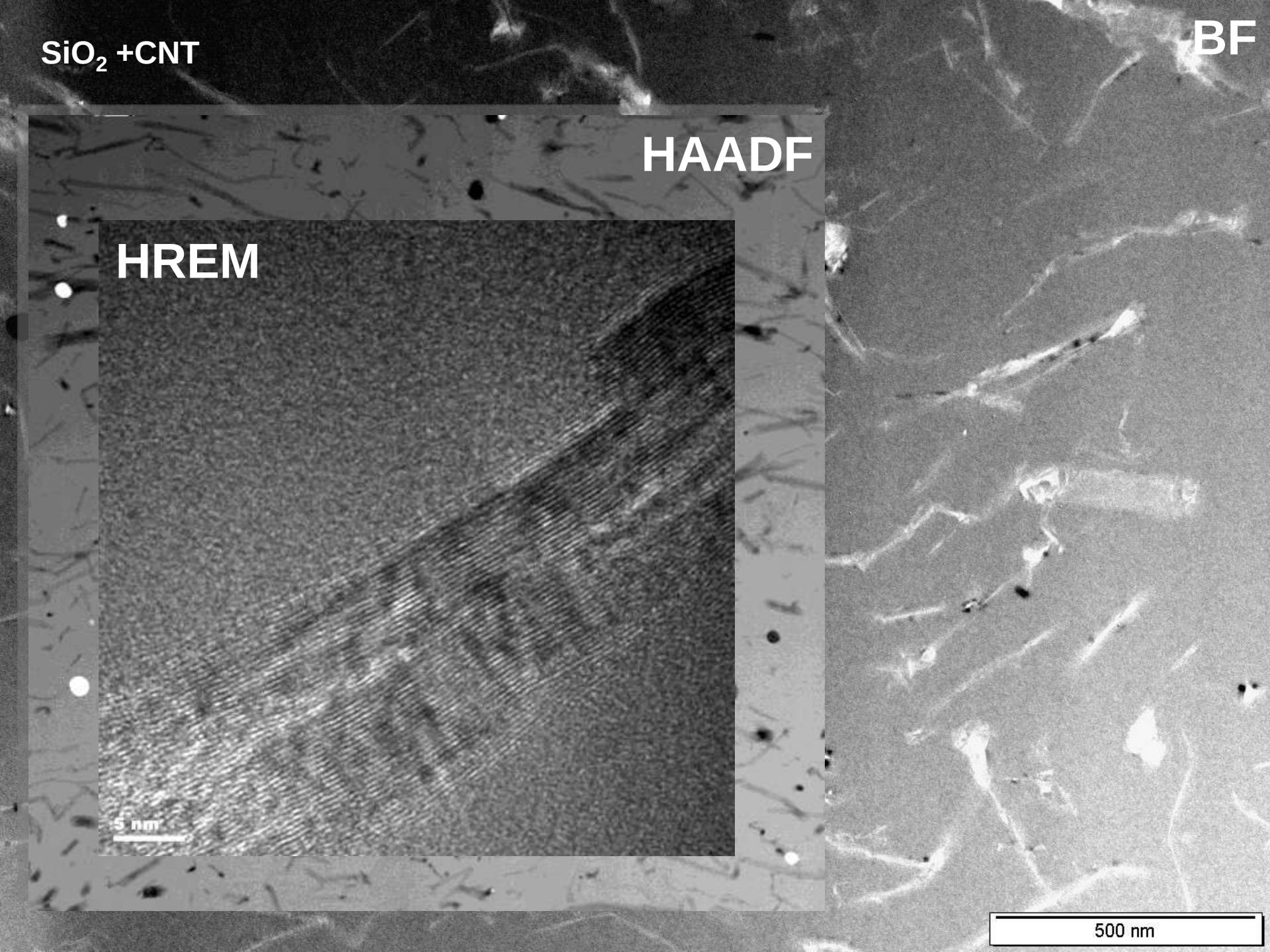


1 μm


HP (7GPa)/LT sintered
STEM / HAADF
100 nm


5 nm
5 nm

Aldo Boccaccini


SiO_2 +CNT
BF
HAADF
HREM
5 nm
500 nm

Cz. II. Nanocomposites: ceramic + CNT - summary

Problems solved:

- Microstructure of powders and compacts of ZrO_2 + CNT was described
- The amorphization tendency of CNT during sintering was proved.
- The possibility of formation of nan-TiC nanowires was showed.
- The possibility of retaining CNT through sintering of bioglas was confirmed.

Problems to be solved:

- Mechanism of formation of nanowires of TiC

Projekty: iNTeg-Risk,

Cz. III. Multilayers

Functional coatings:

(SHS high strength joining)

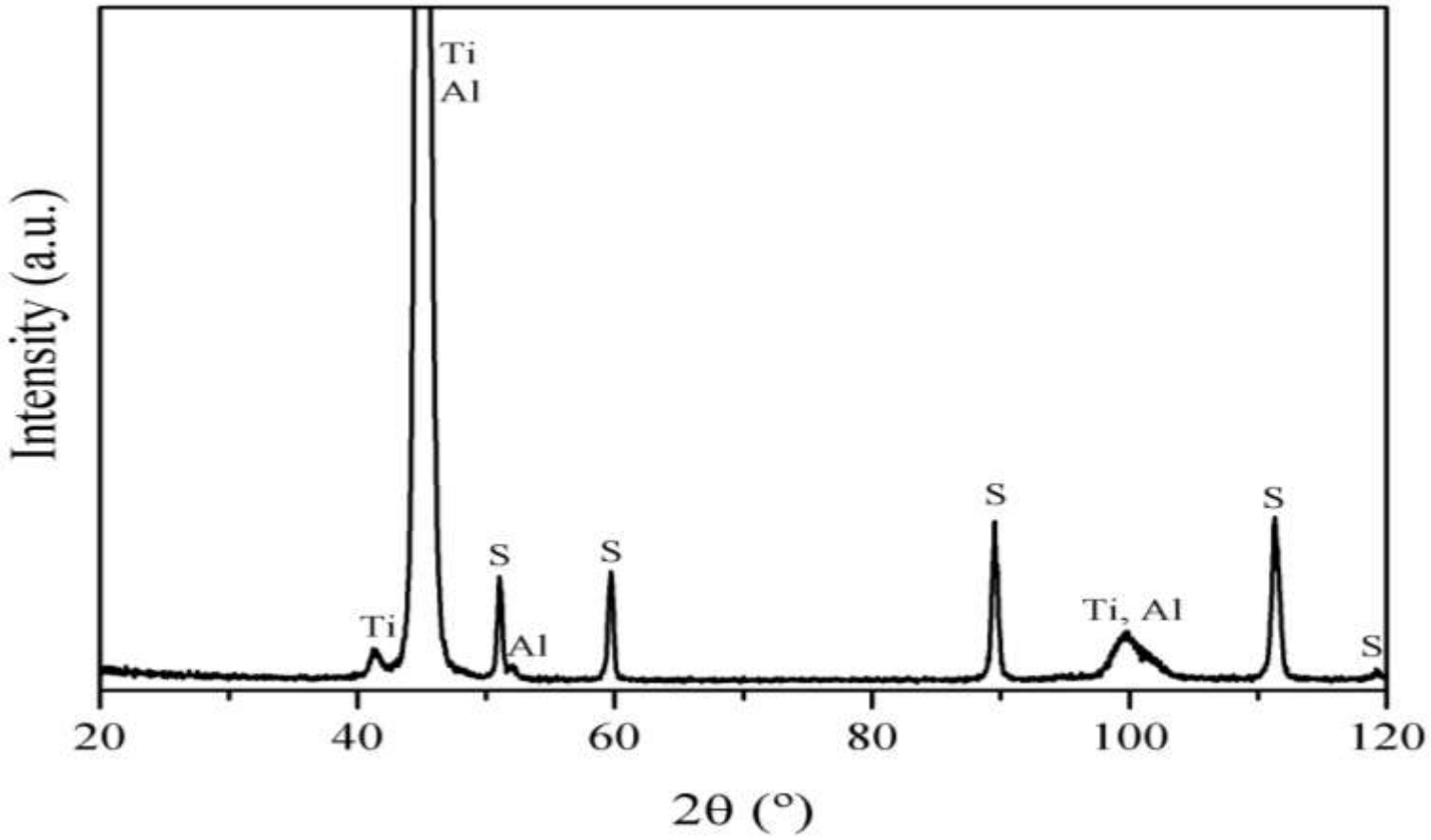
- **AlTi (20 nm)**
  (Ana Sofia Ramos
  University of Coimbra)

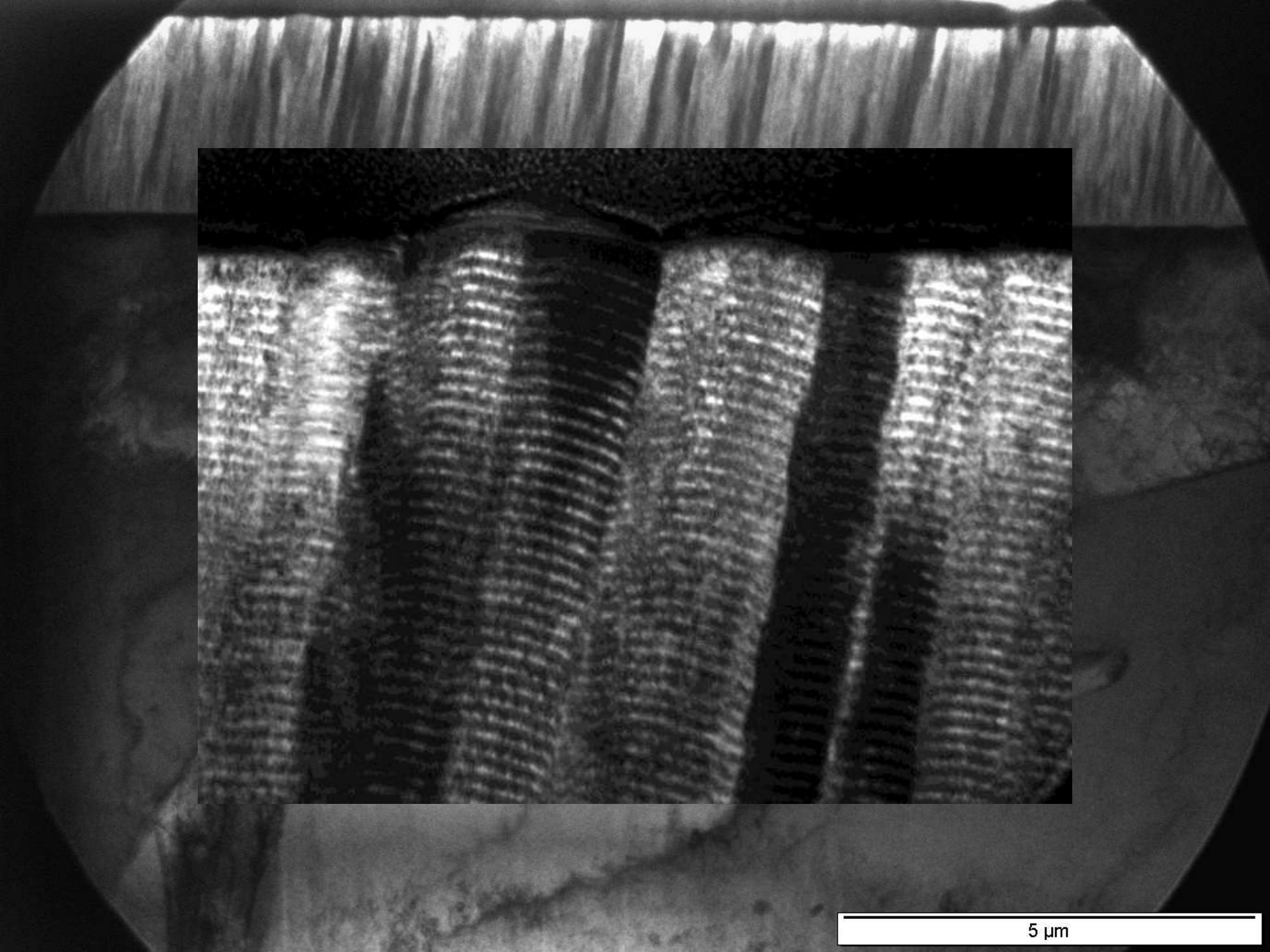
(„anti-wear”)

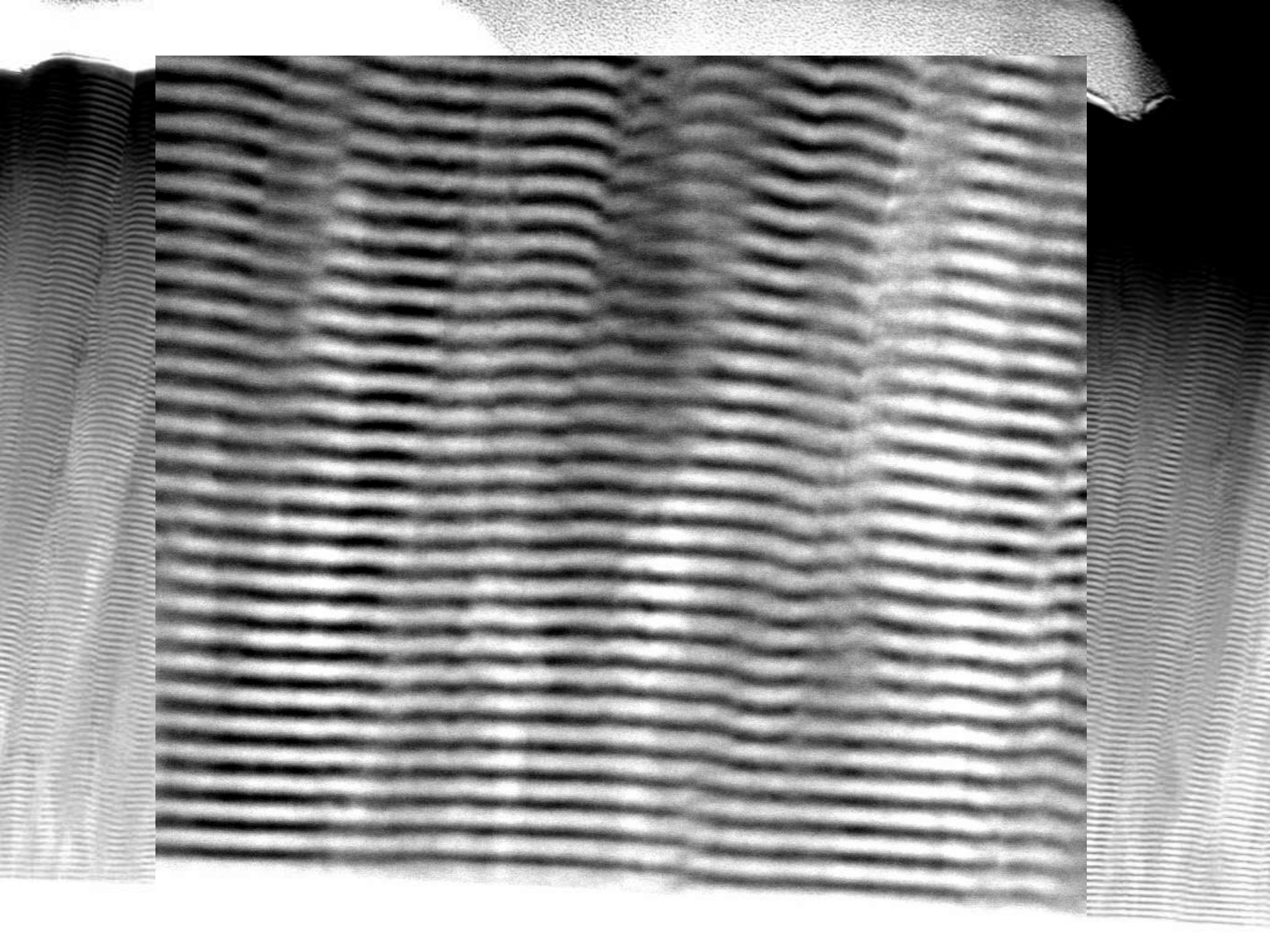
- **CuNi 5 / 5 nm**
  (Paweł Wieczorek/
  Uniwersity of Częstochowa)

Ana Sofia Ramos
Mechanical Engineering Department
Polo II,
University of Coimbra

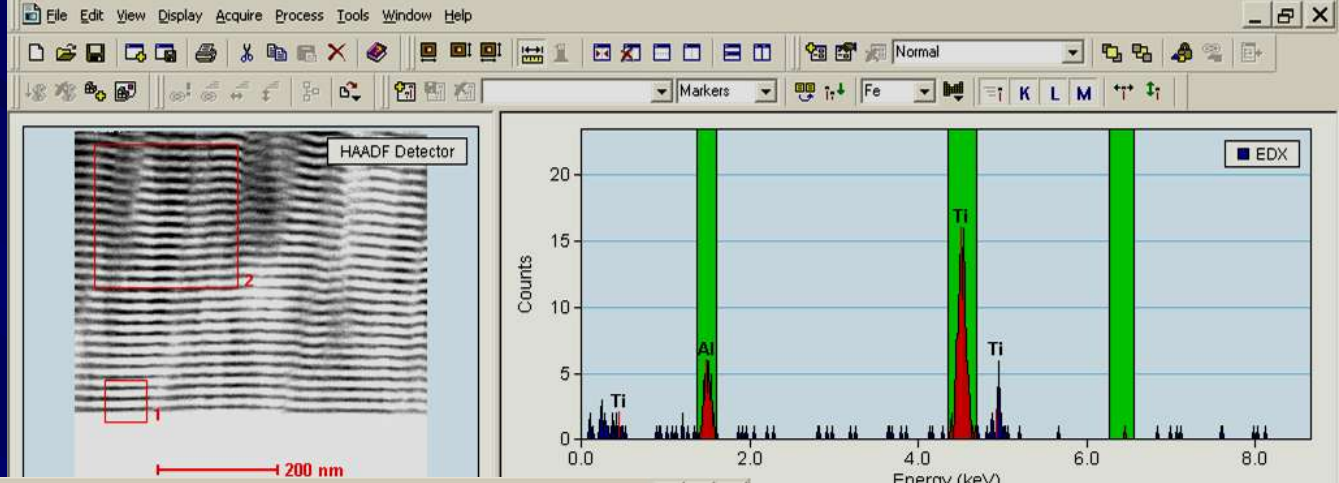
TiAl / 20 nm

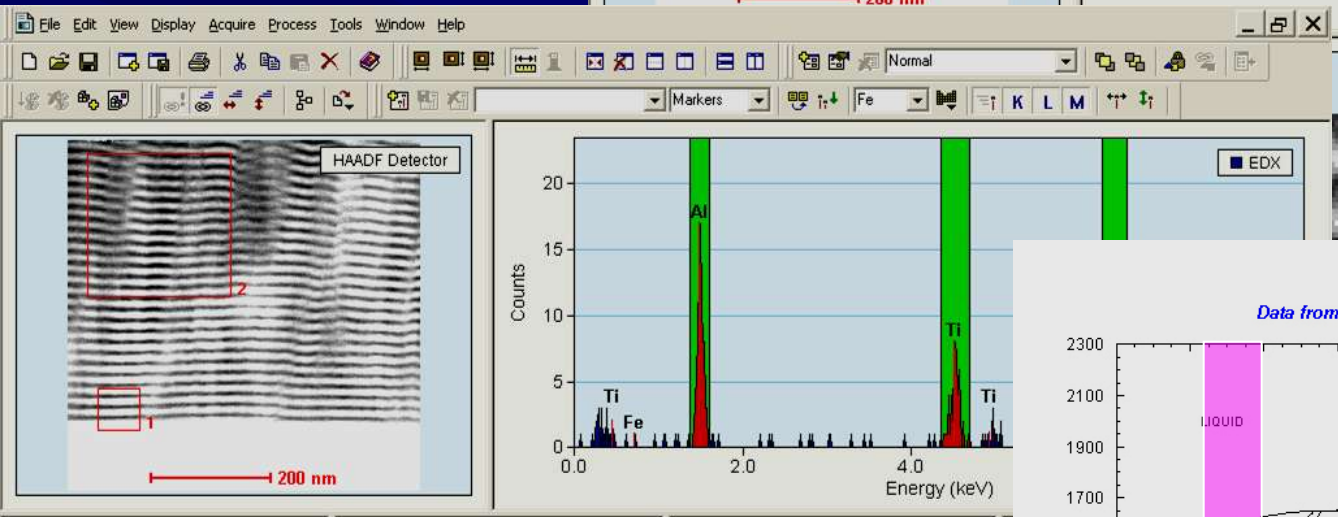


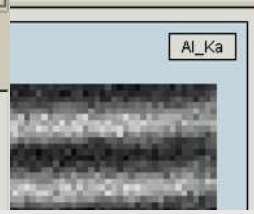

5 µm

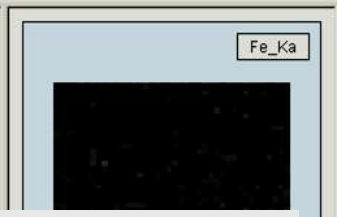


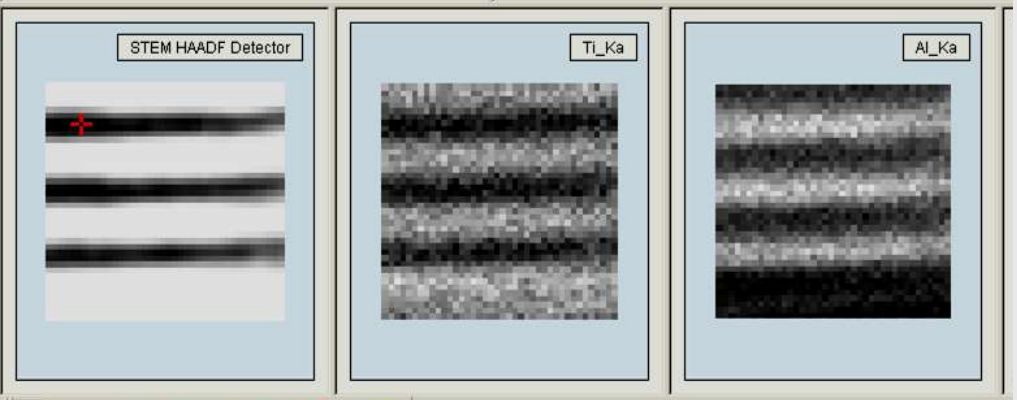
EDS / mappings

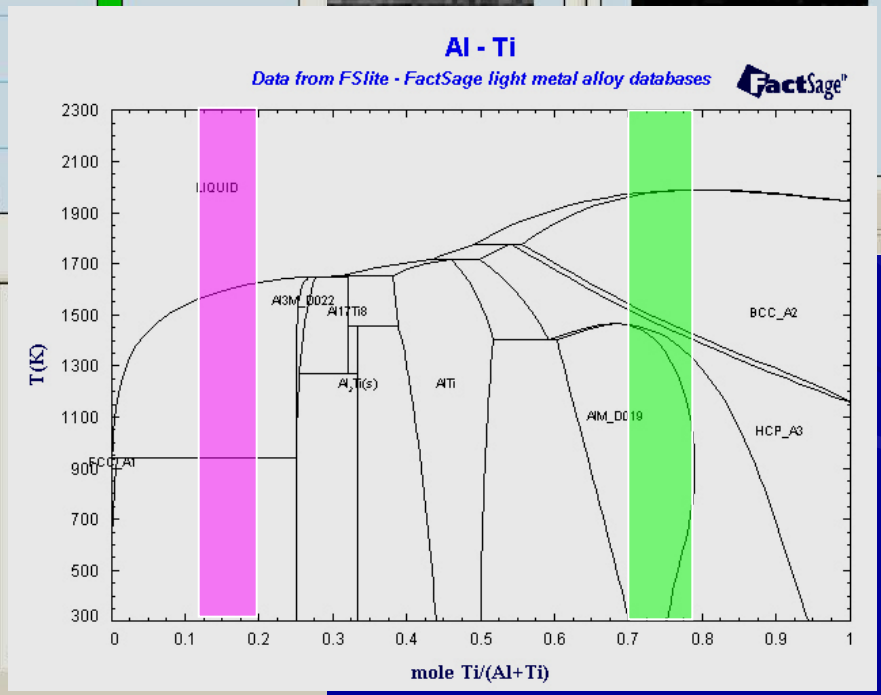












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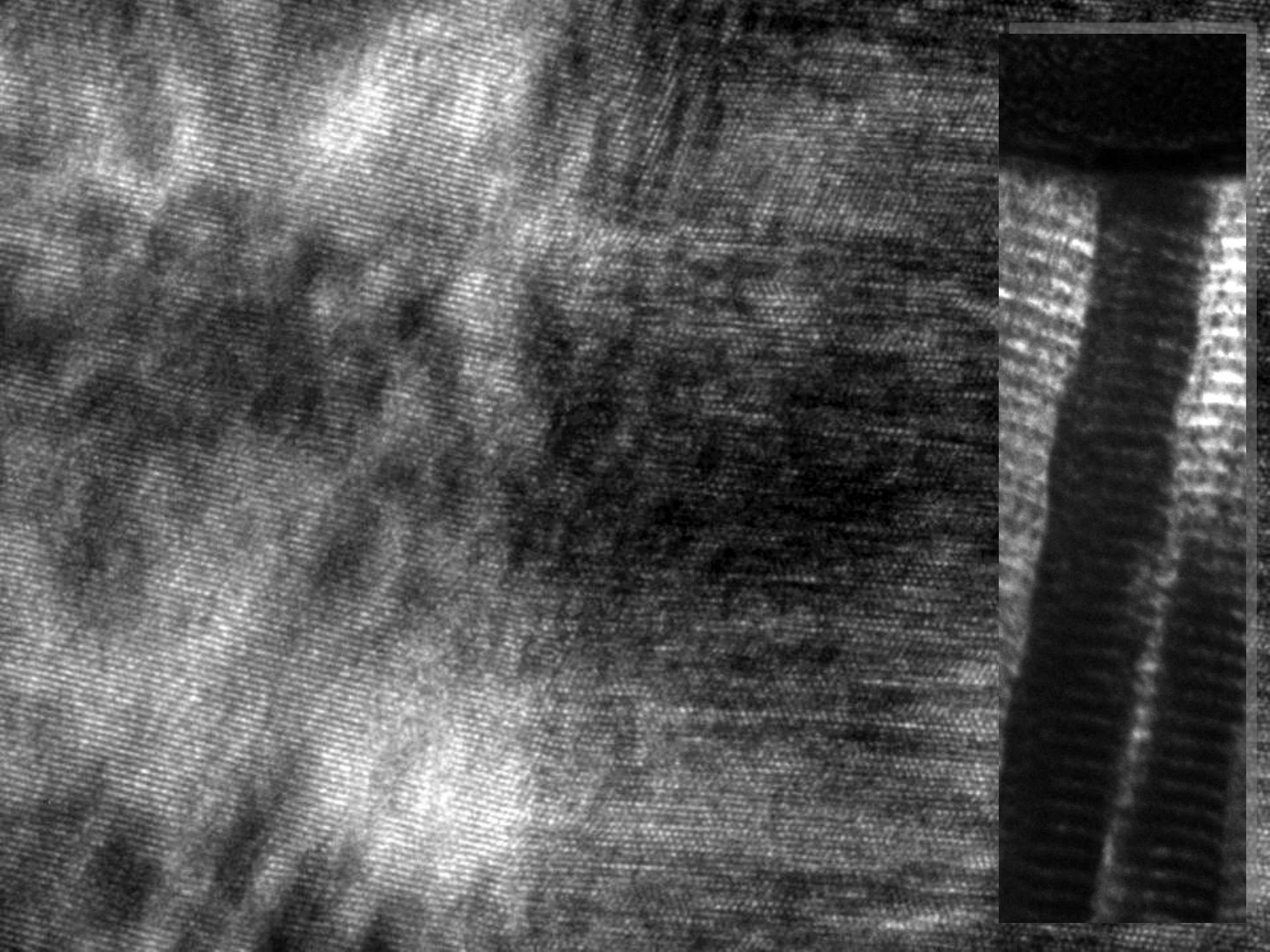


Wielowarstwy Cu/Me

Deposition method

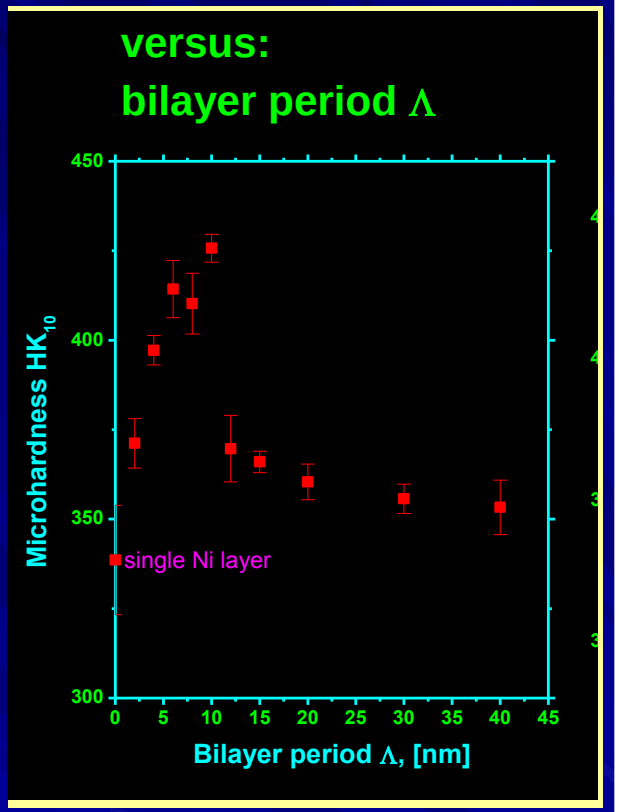
- *single solution, potentiostatic electrodeposition*

Substrates:

- n-type Si (100) Sb - 2×10^{18} 1/cm^3, resistivity - 0.017 Ω·cm
- polycrystalline Cu (99,9 %)

Multilayer system	Bath compsition
Cu/Ni	1.5 M $Ni(SO_3NH_2)_2$ + 0.01 M $CuSO_4$ + 0.5 M H_3BO_3
Co/Cu	1,4 M $CoSO_4$ + 0.008 M $CuSO_4$ + 0,64 M H_3BO_3
NiFe/Cu	0.5 M $Ni(SO_3NH_2)_2$ + 0.01 M $CuSO_4$ + 0.04 M $FeSO_4$ + + 0.4 M H_3BO_3

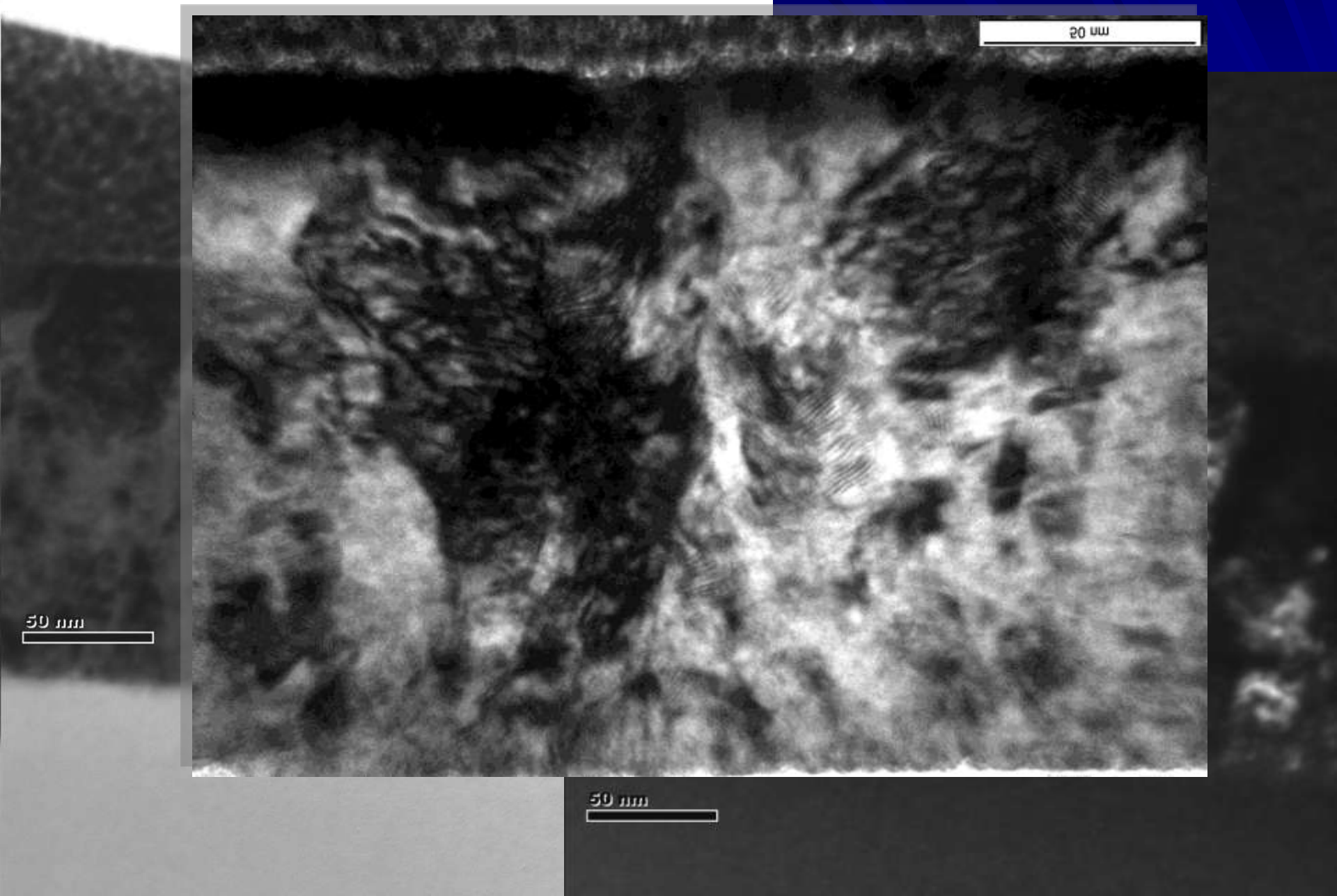
Nr	Multilayer system	Subst.	t_{Cu} [nm]	$t_{Ni, Co, NiFe}$ [nm]	Λ [nm]	n	E_{Cu} [mV]	E_{Ni} [mV]
T14	Cu/Ni	Cu	10	10	20	150	-500	-1300
T98	Cu/Ni	Si	5	5	10	20	-500	-1300
P37	Cu/Co	Si	5	5	10	20	-600	-1200
N11	Cu/NiFe	Si	4	4	8	20	-500	-1200

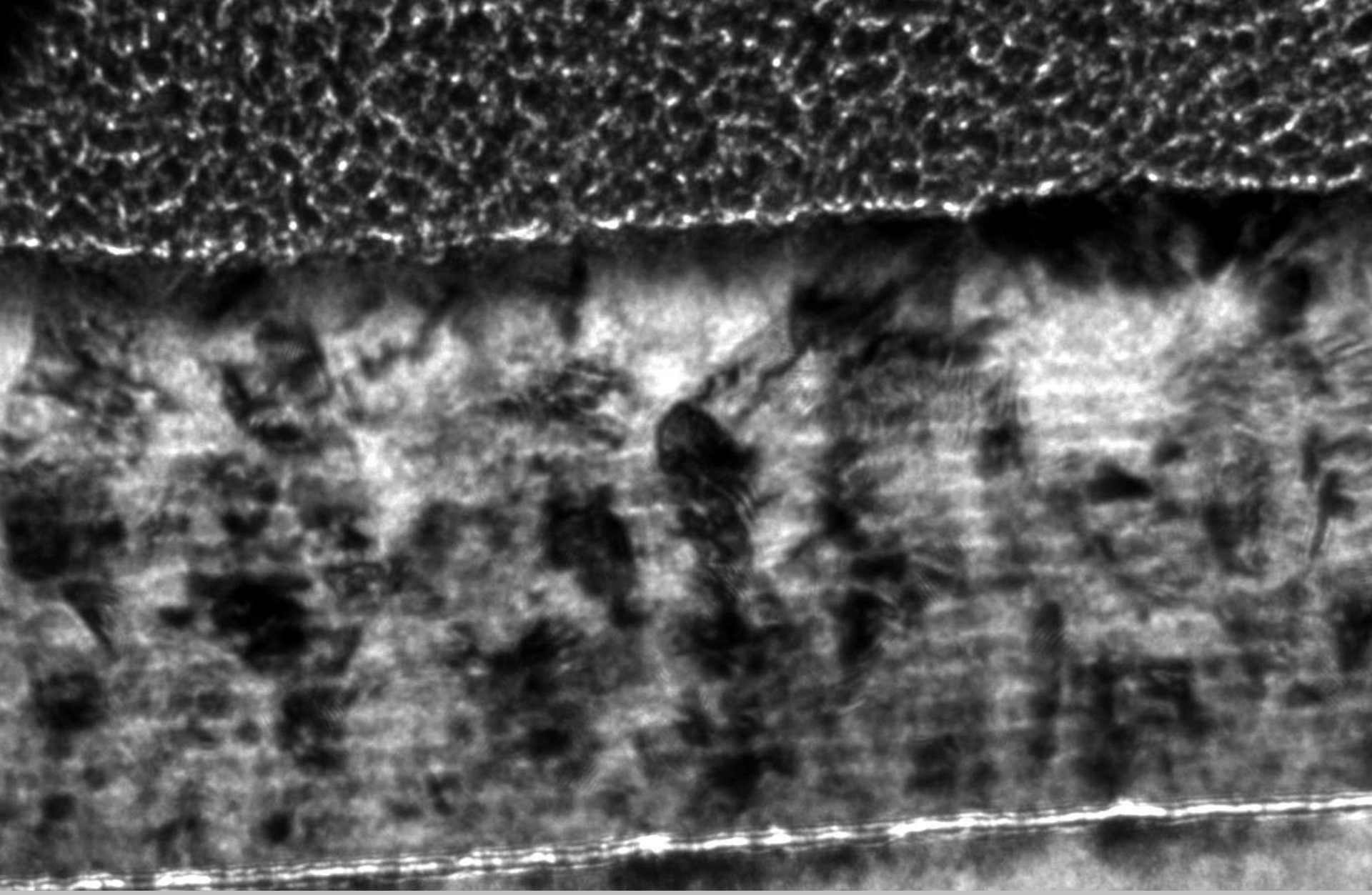


Paweł Wieczorek

Philips CM20

CuNi, 5/5nm (Λ=10nm)

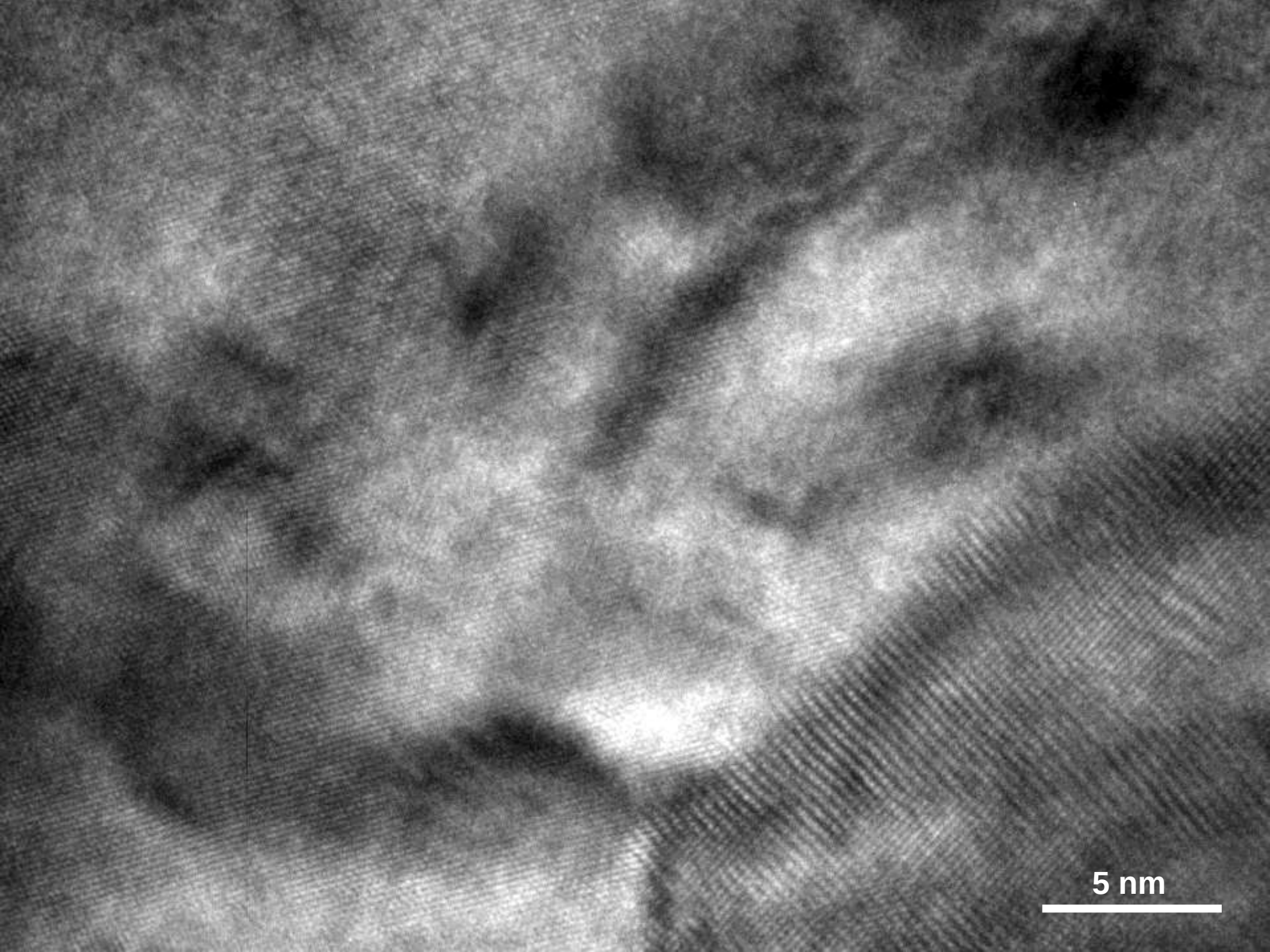


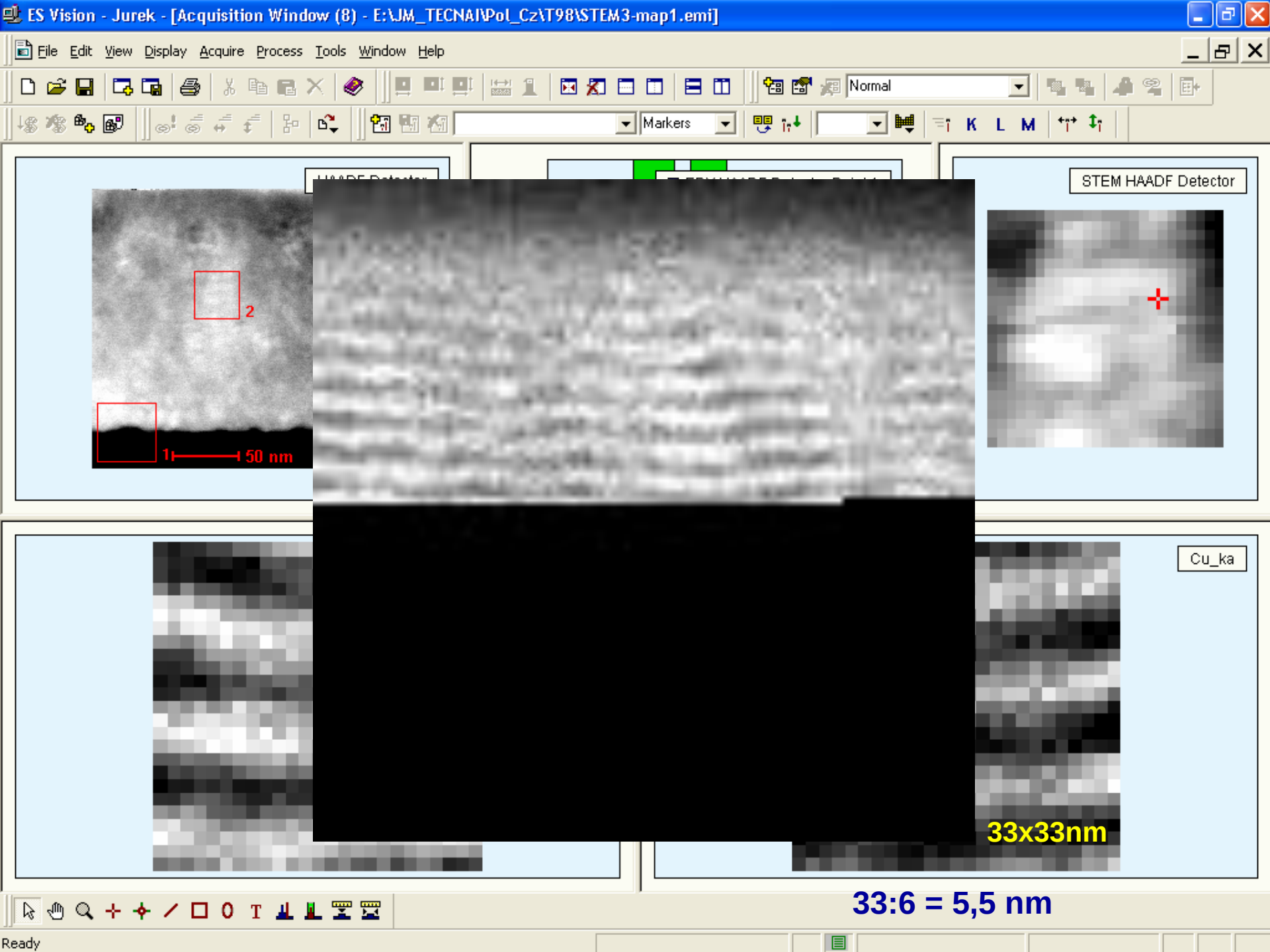


Physics of X-ray Multilayer Structures Technical Digest, ***7*** *(1992) 94-96.*

Effects of Fresnel Fringes on TEM Images of Interfaces in X-Ray Multilayers

Tai D. Nguyen, Michael A. O'Keefe, Roar Kilaas, Ronald Gronsky, Jeffrey B. Kortright


5 nm

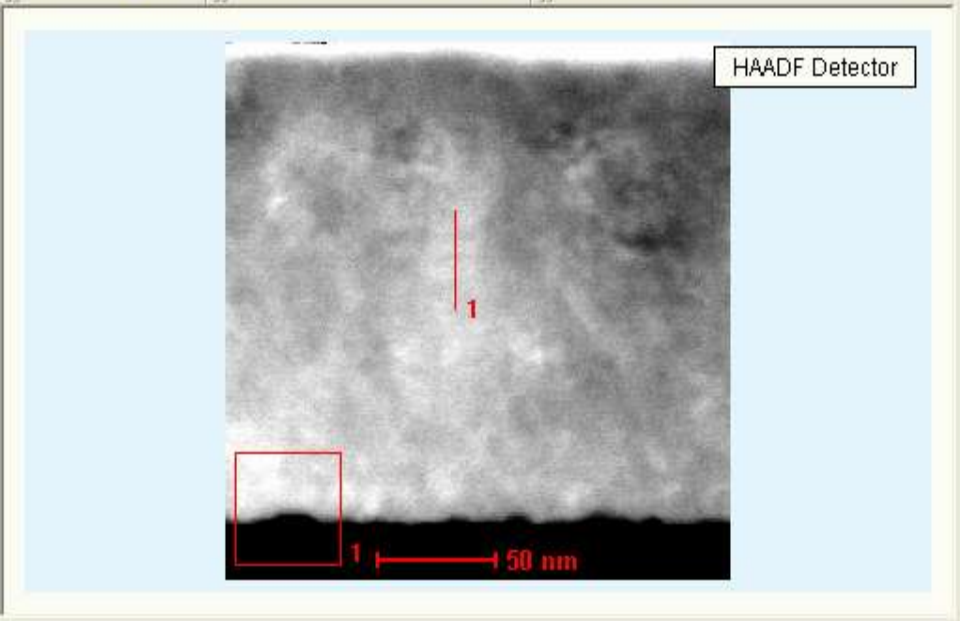

ES Vision - Jurek - [Acquisition Window (8) - E:\JM_TECNAI\Pol_Cz\T98\STEM3-map1.emi]
File Edit View Display Acquire Process Tools Window Help
Normal
Markers
K L M
STEM HAADF Detector
2
1
50 nm
Cu_ka
33x33nm
33:6 = 5,5 nm
Ready

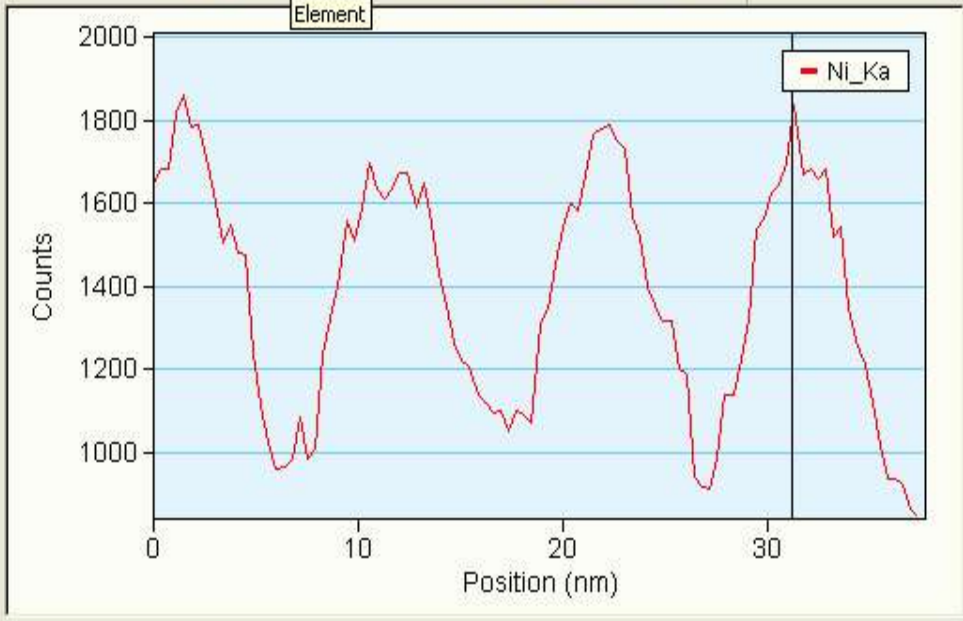
File Edit View Display Acquire Process Tools Window Help

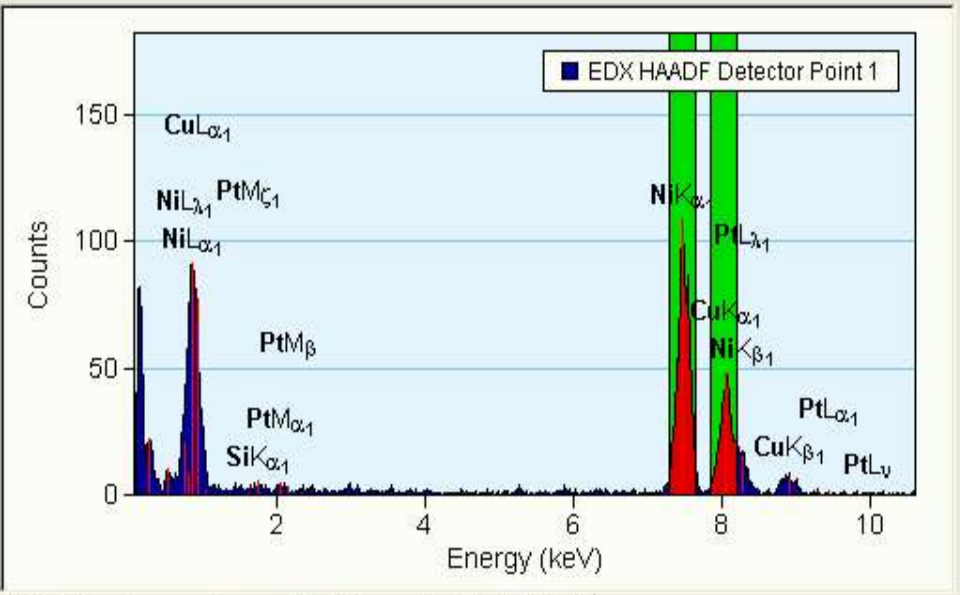
Normal

Markers

Element K L M







Cz. III. Multilayers

- summary

<u>Problems solved</u>:

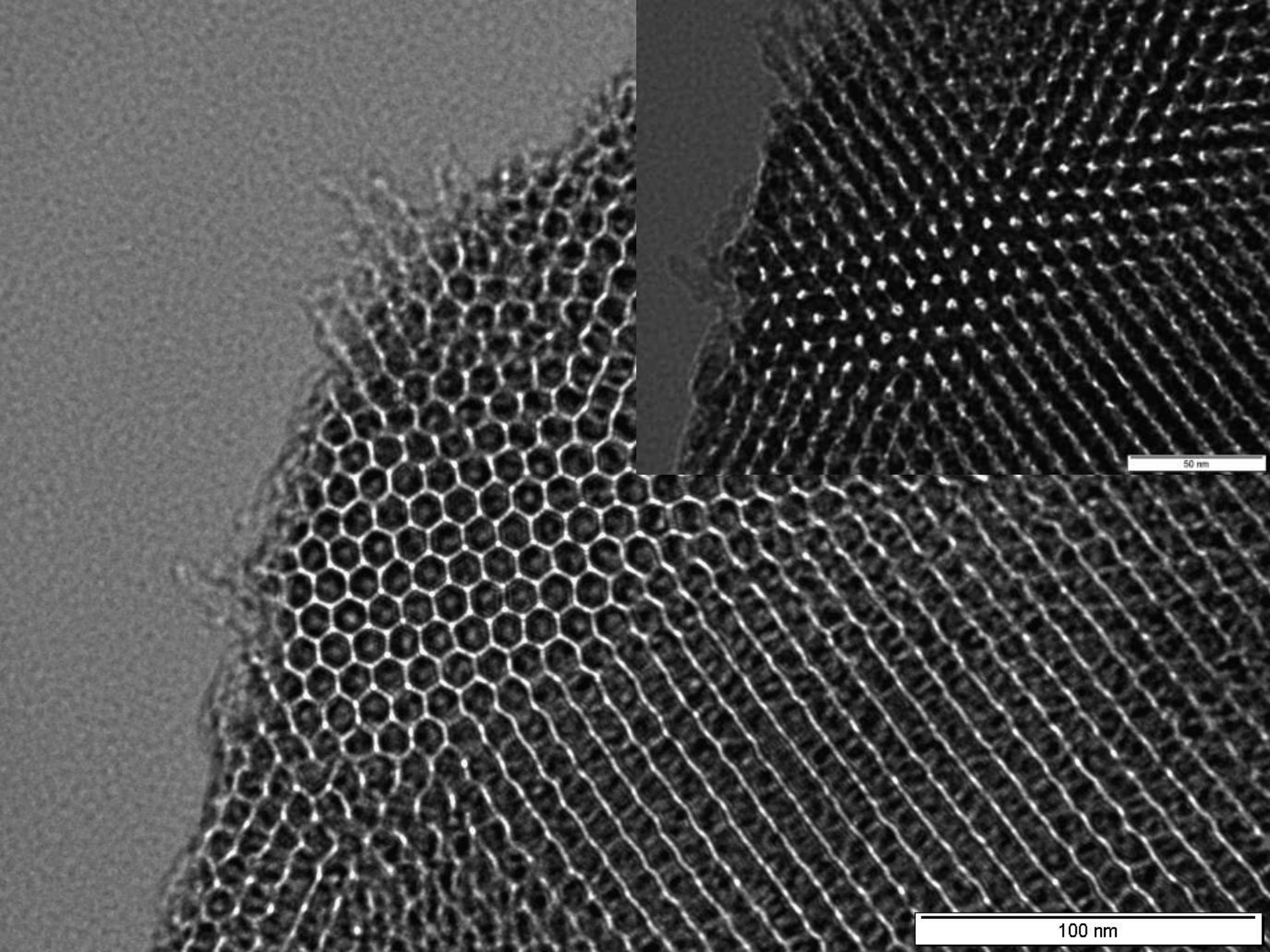
- **The microstructure, phase and chemical content of n(Ti/Al) and n(Cu/Me) coatings was described**

<u>Problems to be solved:</u>

- **Analysis of defects in the multilayerd structure**
- **Quantitative measurements of layers chemical composition**

Convergence **Ro**utes for **Na**nomaterials **Ch**aracterization

HArd **N**ano**CO**mposite **C**oatings


50 nm
100 nm