CEA activities in 2021:

Raman, SEM, and CLSM characterization of selected Be and W reference samples

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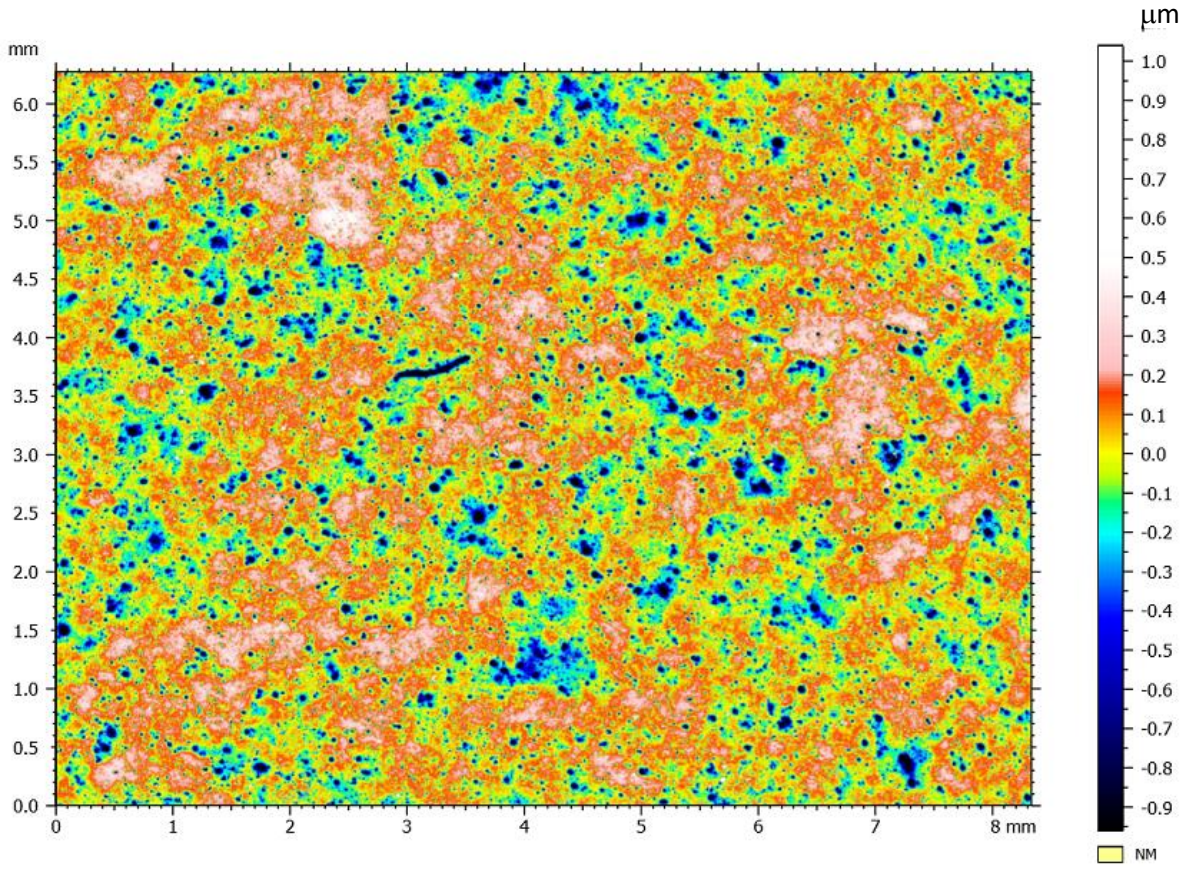
D3	Raman, SEM, and CLSM characterization of selected Be and W reference samples (CEA)

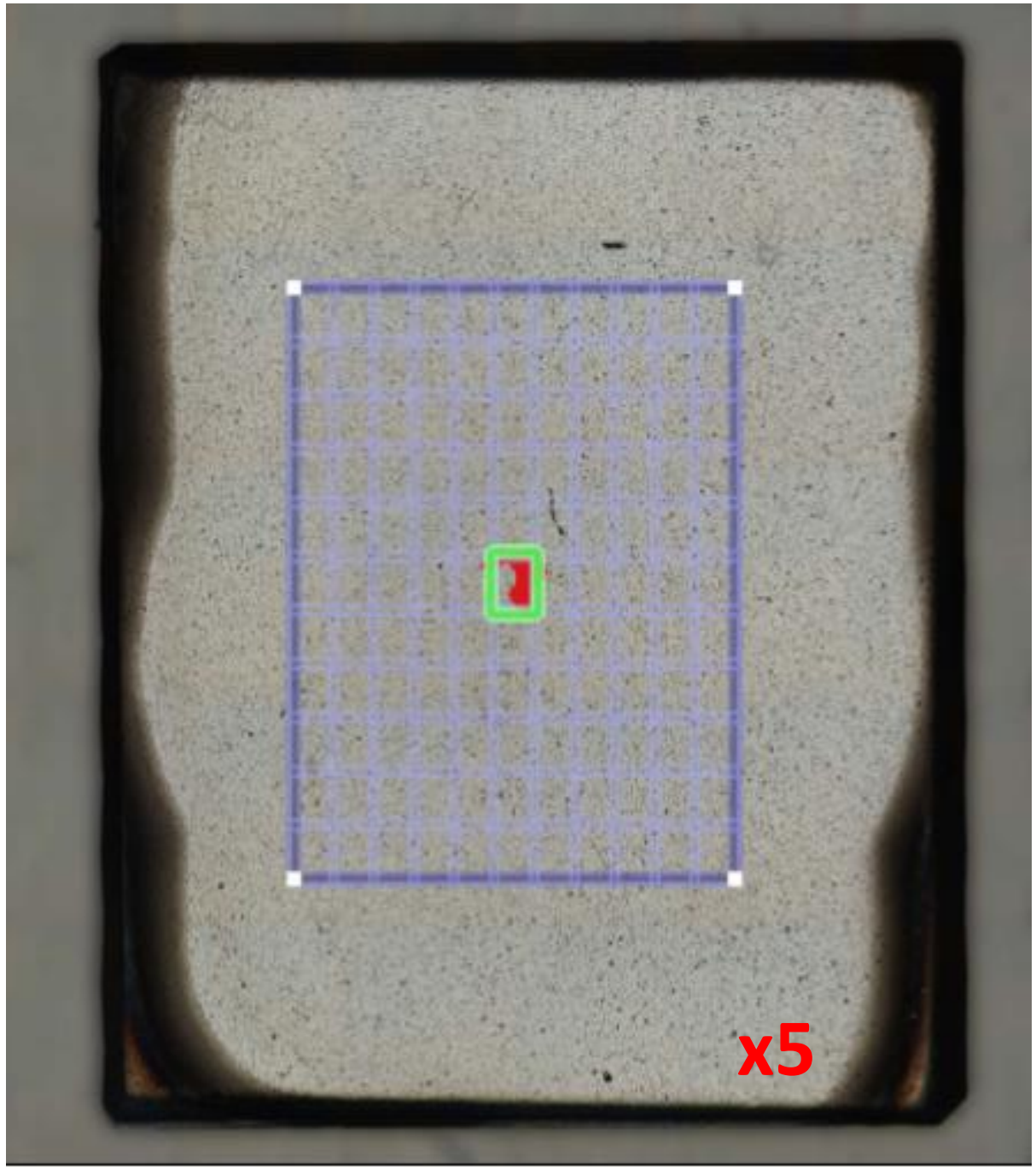
Aim of this presentation:

- Show possibilities on Confocal, electronic and Raman microscopies (AFM?)
- State of the art of Raman microscopy
- How to go a step further by coupling to other techniques (TDS, XRD,…)
- 1 little problem

CLSM - *For basic characterization*

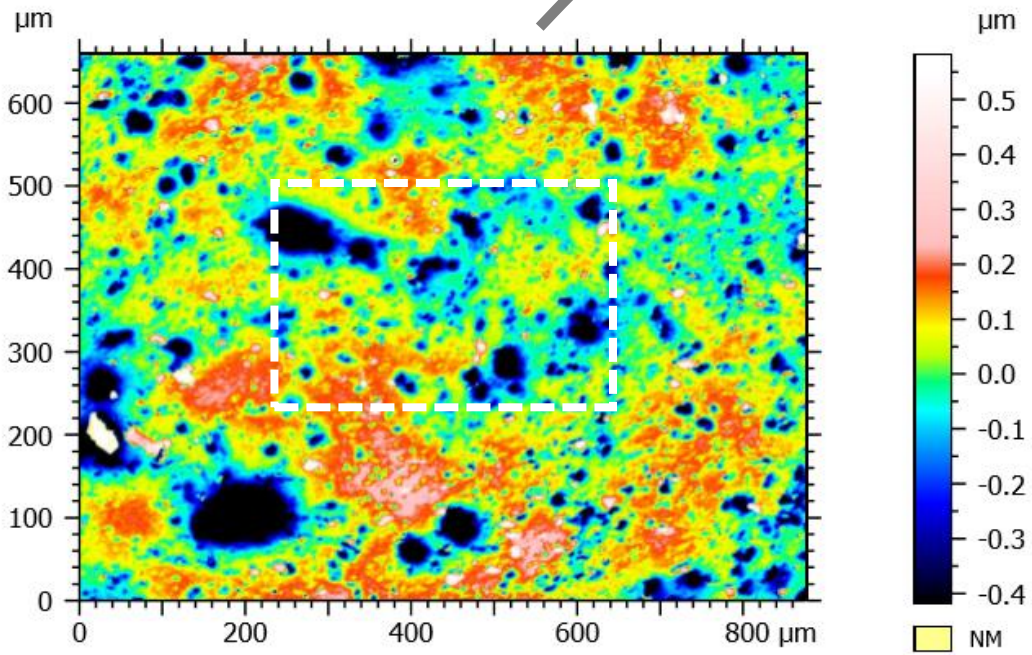
2020- Be D5 H5 (RT)



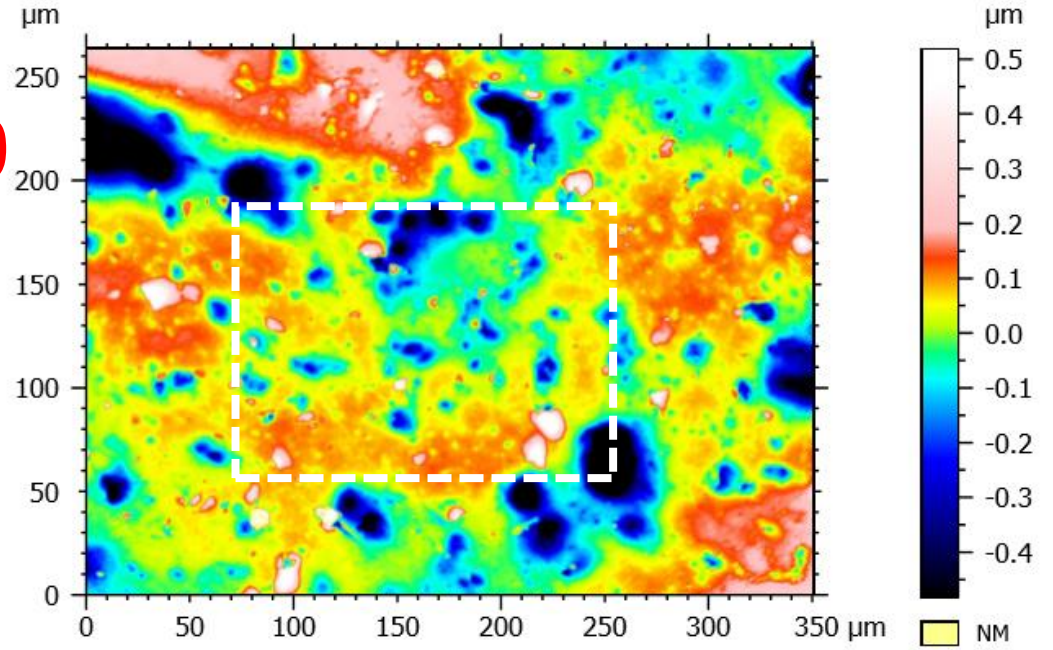


CLSM - *For basic characterization*

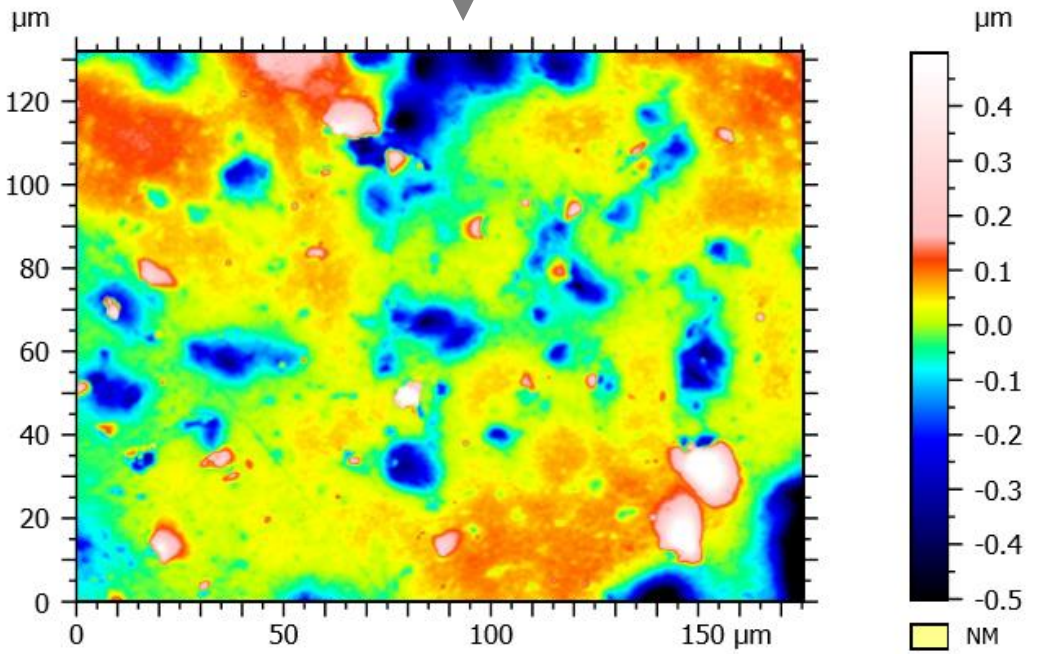
x20



x50

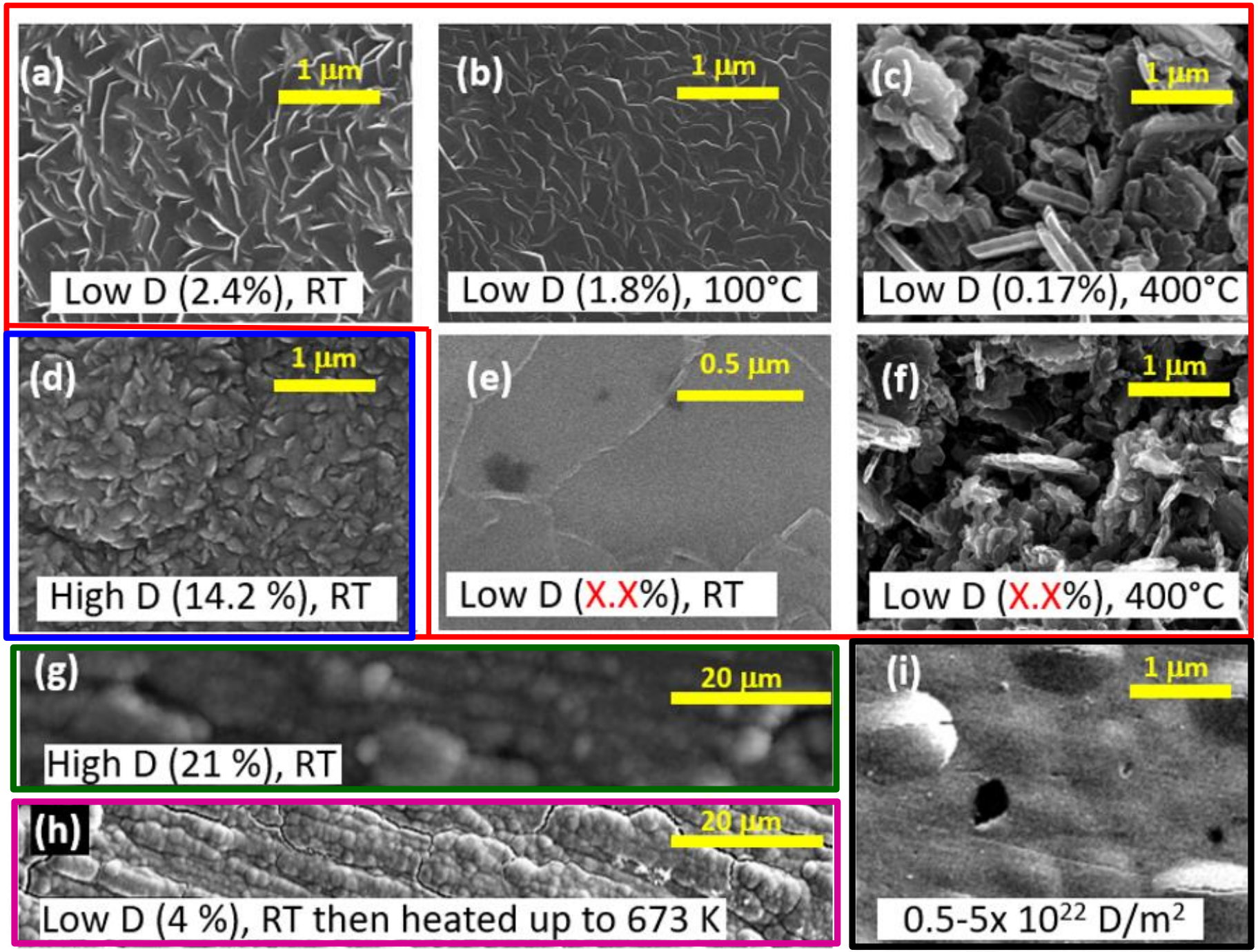


x100



SEM

For basic characterization

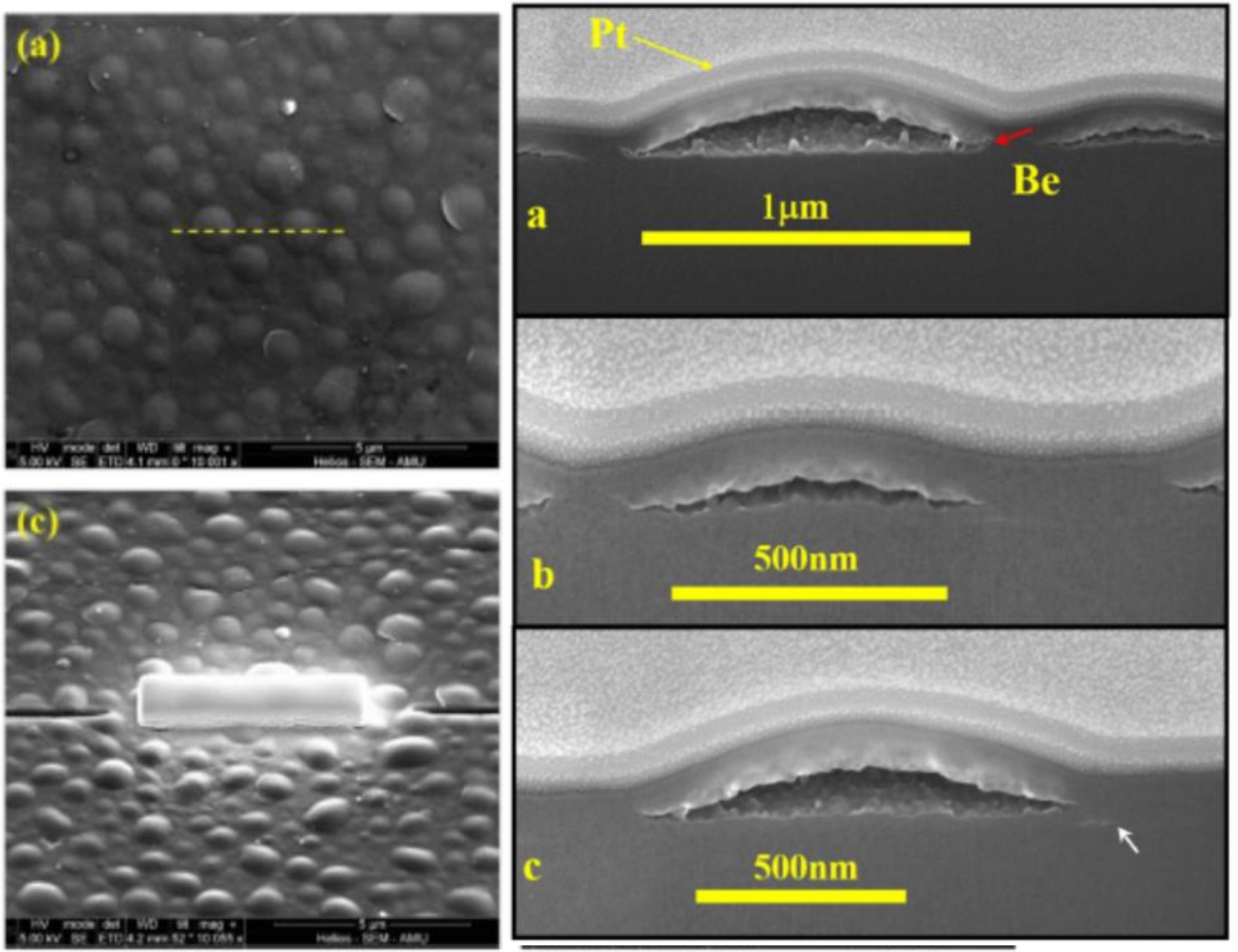


SEM of cross section (FIB cut)

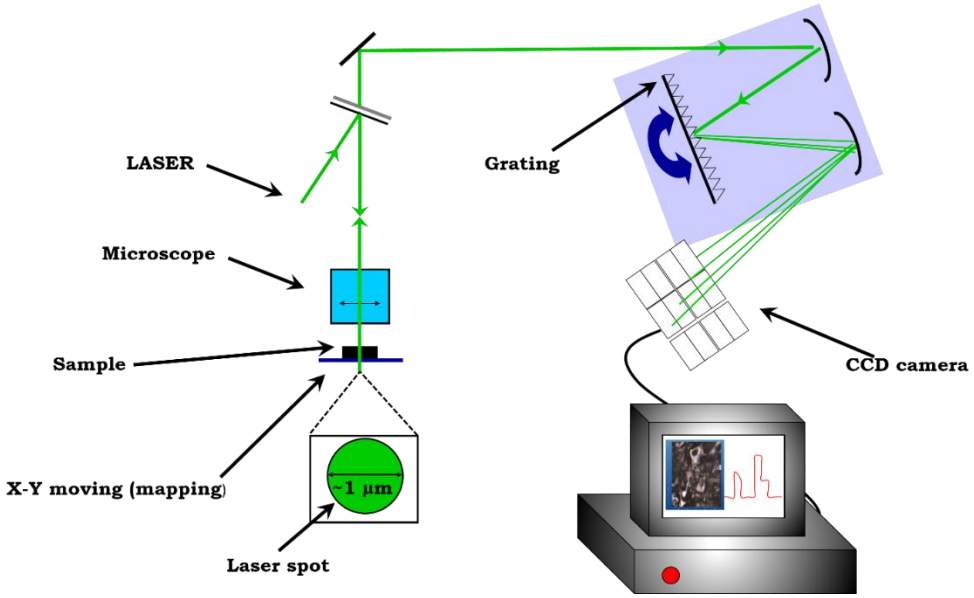
For basic Characterization

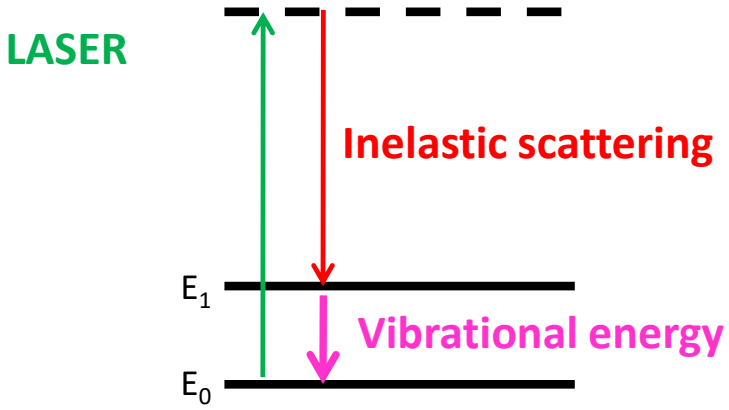
(on very limited number of samples)

From Mohit Kumar's thesis



Raman microscopy





- Depth probed for Be and W ≈ *30 nm*
- *1 spectrum : 1µm²*
- *Statistics: hundreds of 1µm²*
- *Probes phonons and vibration*
- *Playing with power:*

Raman microscopy

Be

Raman active

BeO

Raman active

BeD

Raman active

W

Raman inactive

WO

Raman active

Trapped D_2

Raman active

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Nuclear Fusion
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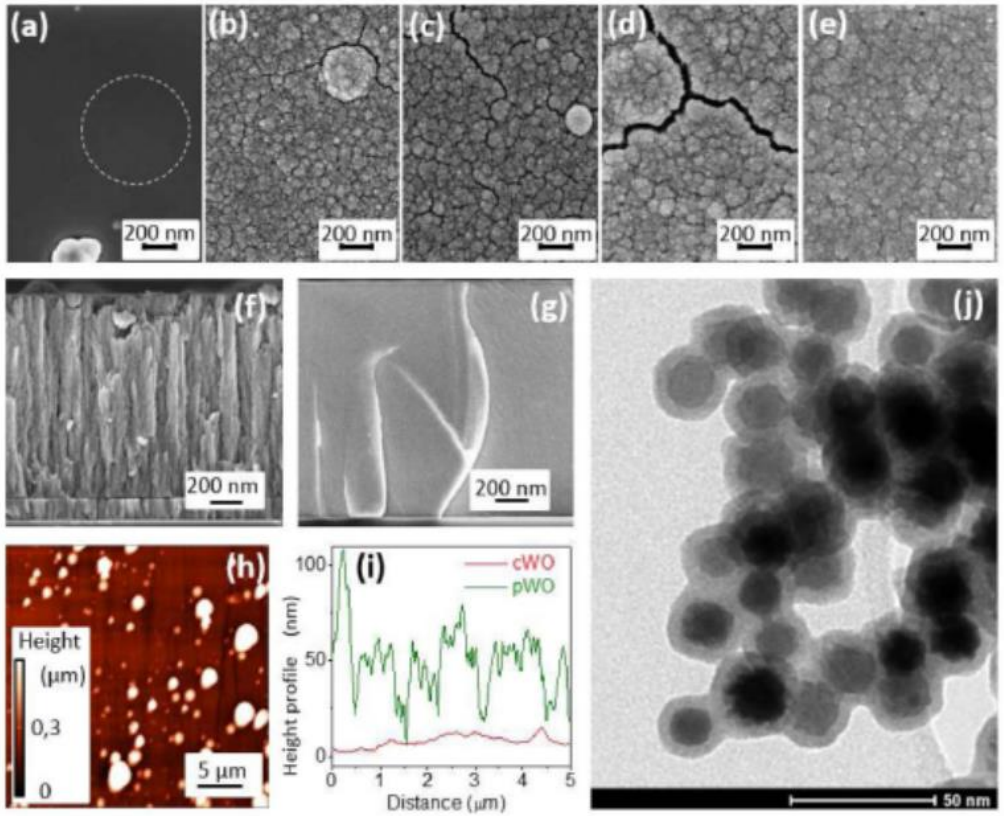
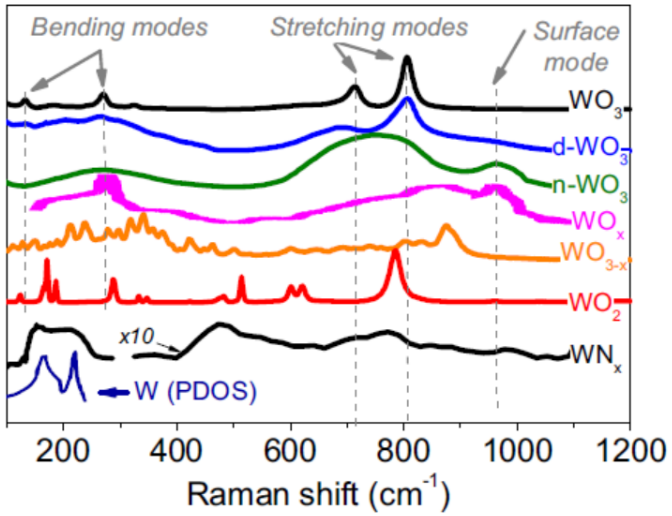
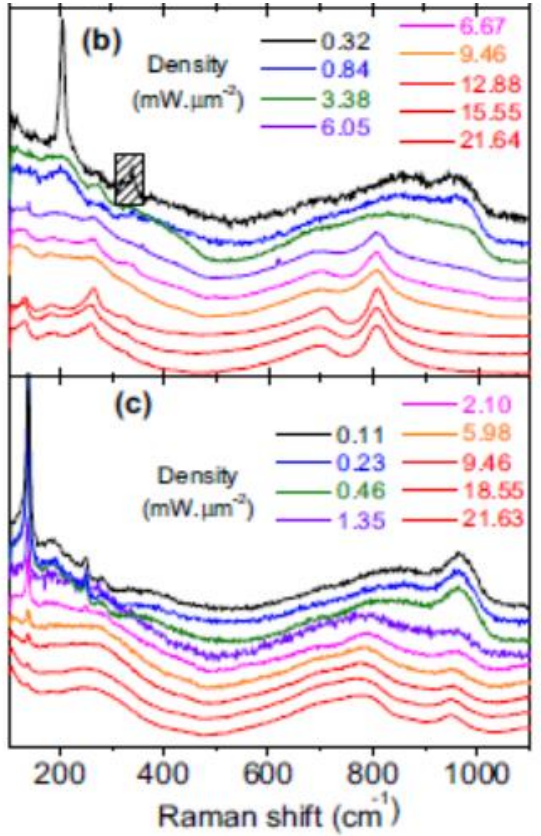
Post-mortem analysis of tungsten plasma facing components in tokamaks: Raman microscopy measurements on compact, porous oxide and nitride films and nanoparticles

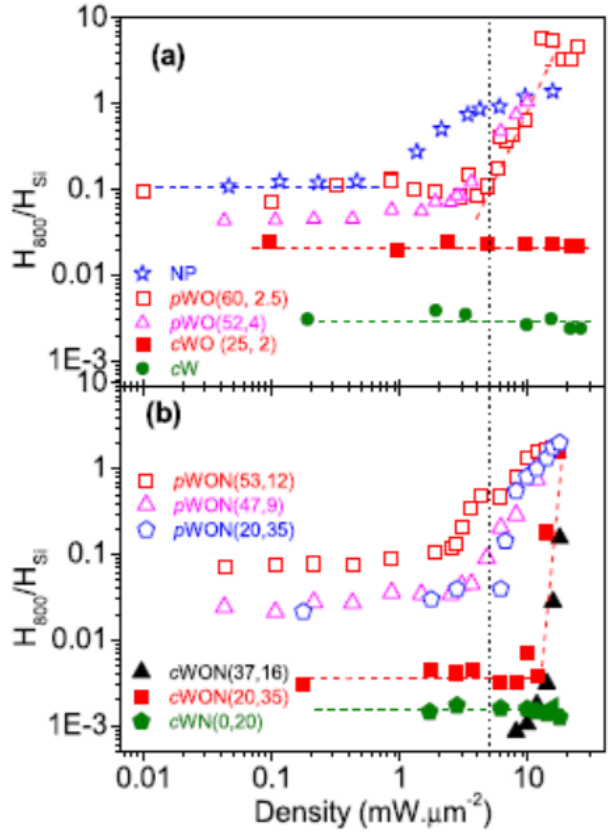
C. Pardanaud[1], D. Dellasega[2,3], M. Passoni[2,3], C. Martin[1], P. Roubin[1], Y. Addab[1], C. Arnas[1], L. Couëdel[1,4], M. Minissale[1], E. Salomon[1], G. Giacometti[1], A. Merlen[5], E. Bernard[6], R. Mateus[7], E. Alves[7], Z. Siketic[8], I. Bogdanovic Radovic[8] and A. Hakola[9]





W / WO

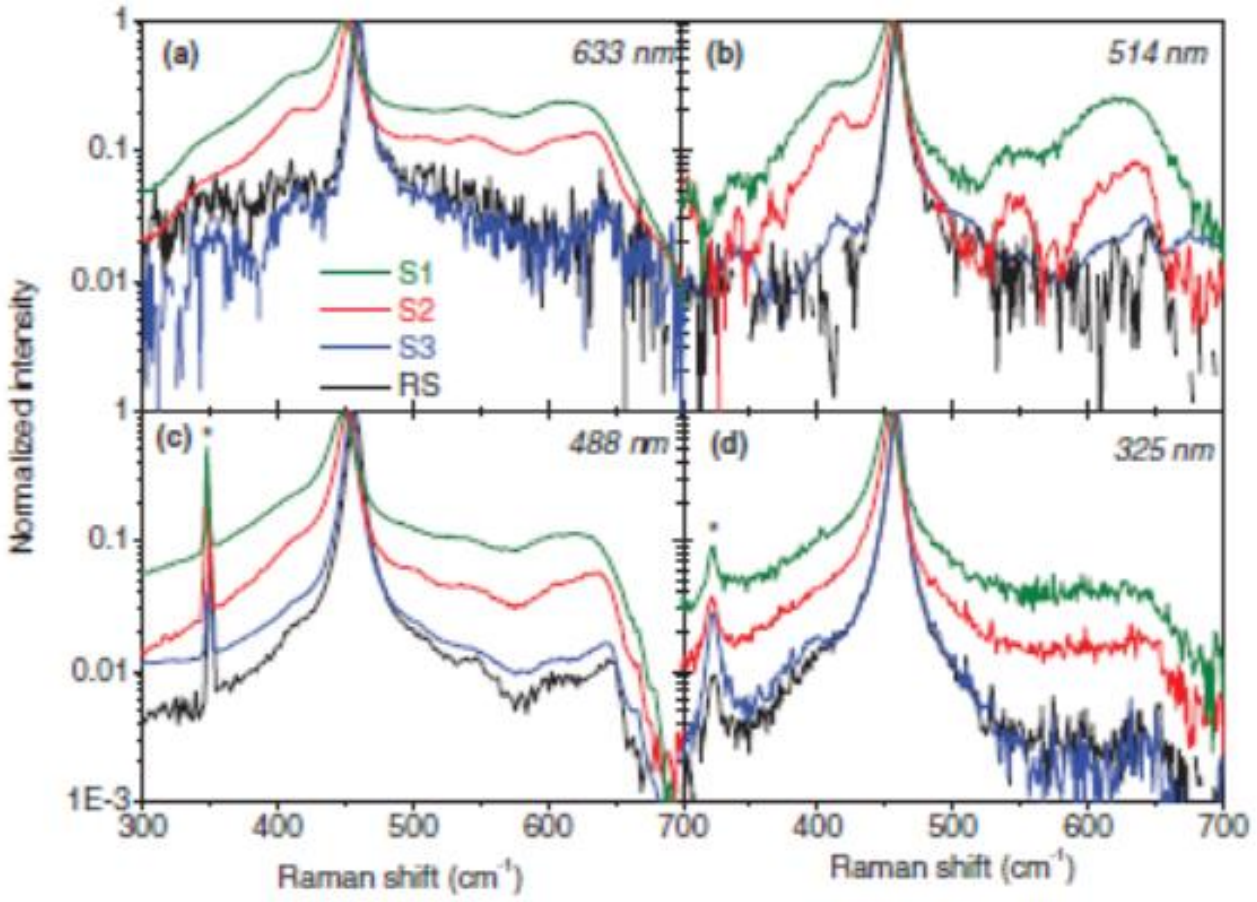




IOP Publishing | International Atomic Energy Agency Nuclear Fusion
Nucl. Fusion 57 (2017) 076035 (15pp) https://doi.org/10.1088/1741-4326/aa70bb

Preparing the future post-mortem analysis of beryllium-based JET and ITER samples by multi-wavelengths Raman spectroscopy on implanted Be, and co-deposited Be

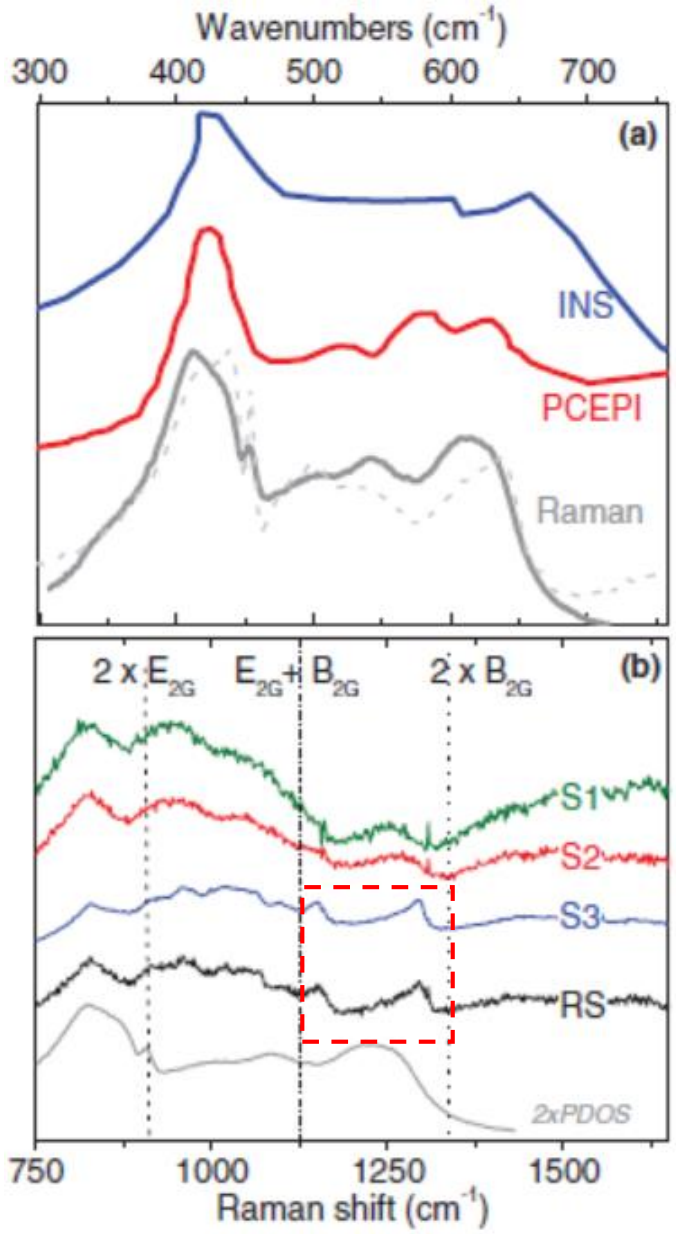
M.I. Rusu[1,2], C. Pardanaud[2], Y. Ferro[2], G. Giacometti[2], C. Martin[2], Y. Addab[2], P. Roubin[2], M. Minissale[2,6], L. Ferri[2,3], F. Virot[3], M. Barrachin[3], C.P. Lungu[4], C. Porosnicu[4], P. Dinca[4], M. Lungu[4], M. Köppen[5], P. Hansen[5] and Ch. Linsmeier[5]



Be / defective-Be / BeC

PDOS

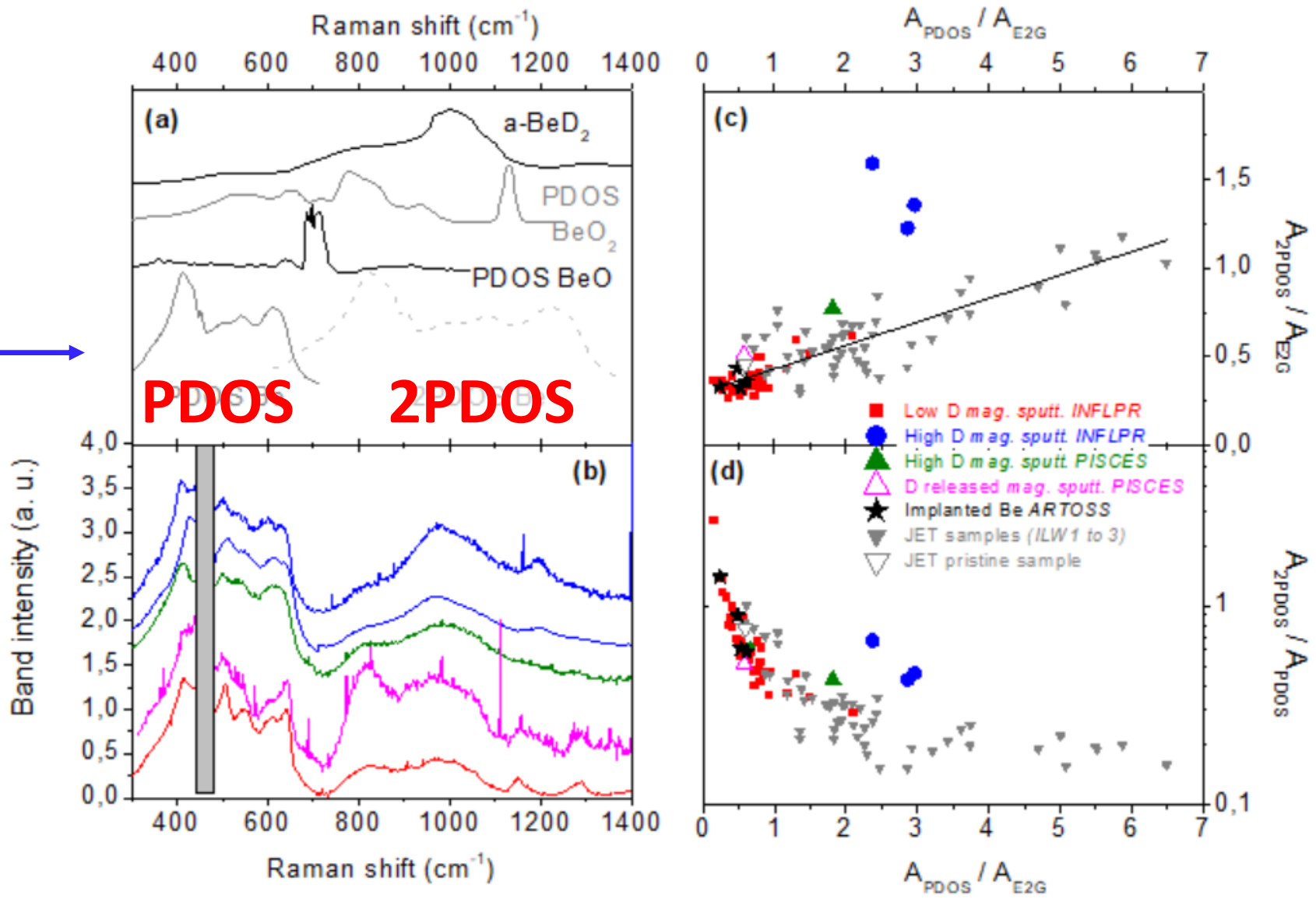
2PDOS



PFMC 2021

a-BeD_2 / defective-Be

Defective-Be →



Conclusion (?)

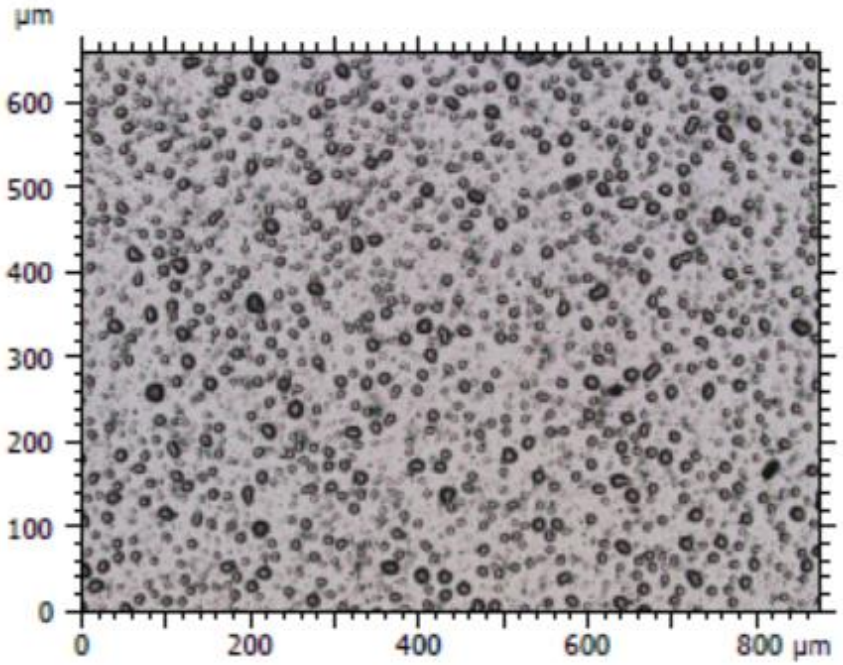
- D behavior: a-BeD_2 observed in 20% D samples VS TDS ?

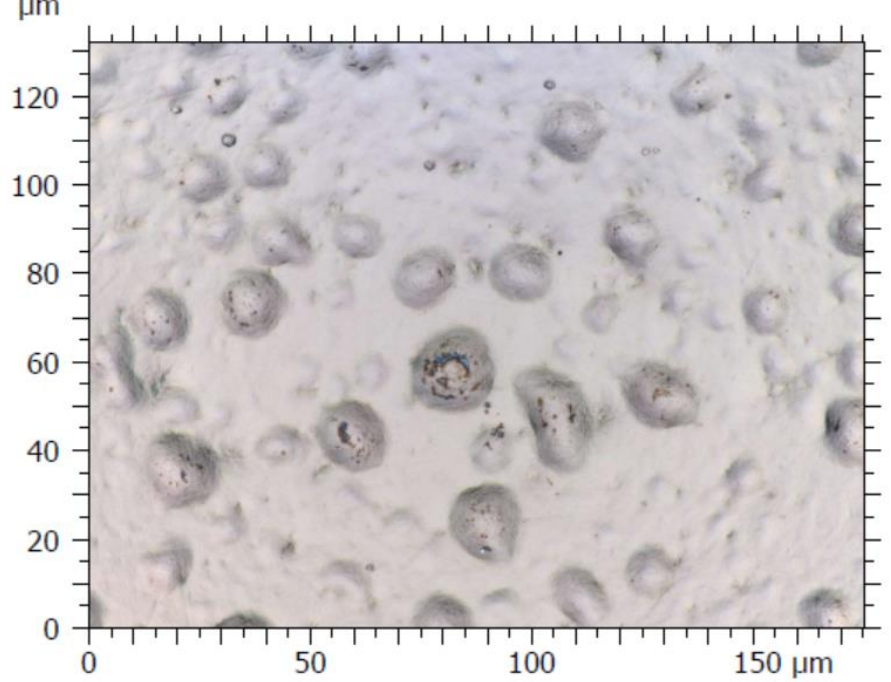
- A_{2PDOS}/A_{PDOS} VS crystallite size (XRD)

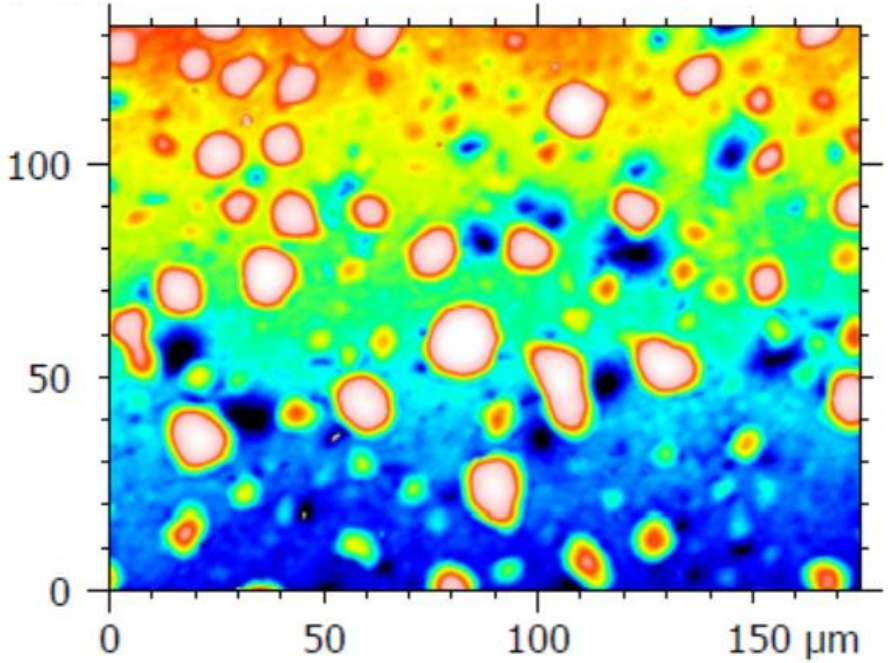
- Acquisition of a low frequency filter (10-100 cm^{-1} range accessible)

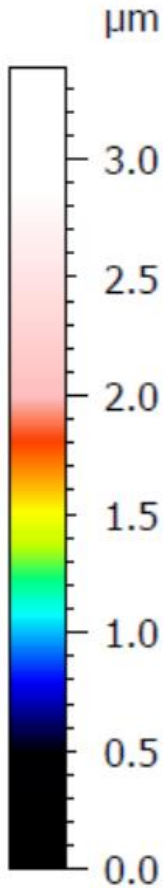
- *Future: characterization of dusts? Glove box but need safety protocol*

Observations: (1)





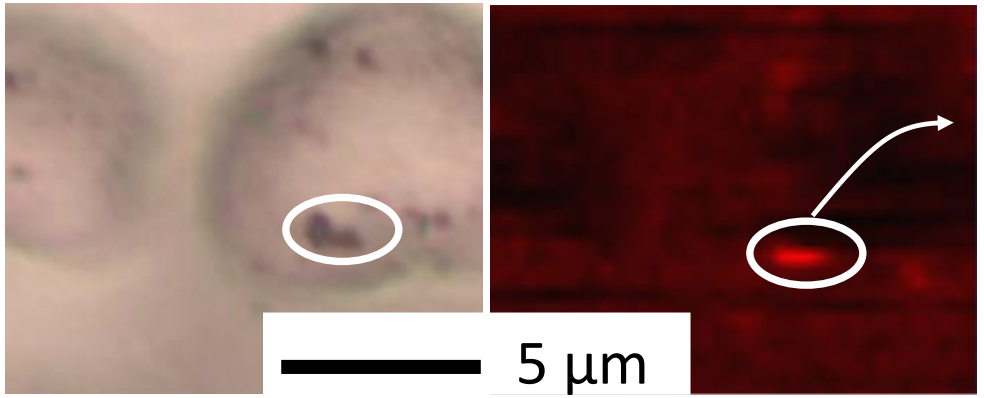




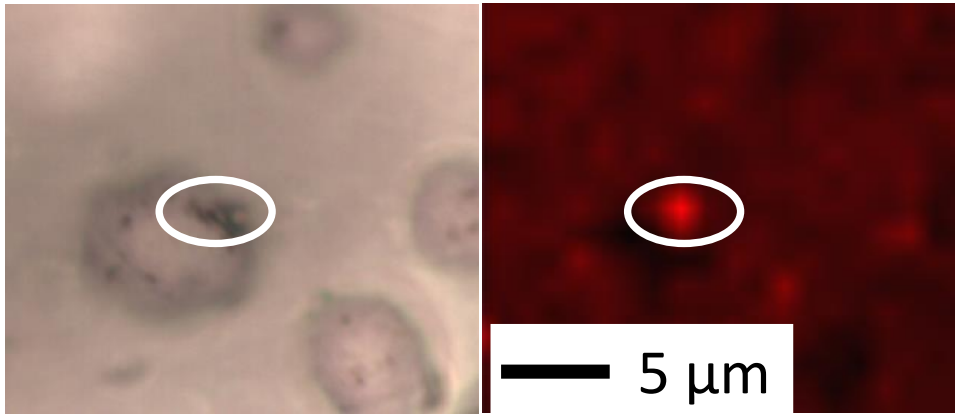
BeD5Ne2.5 - T100

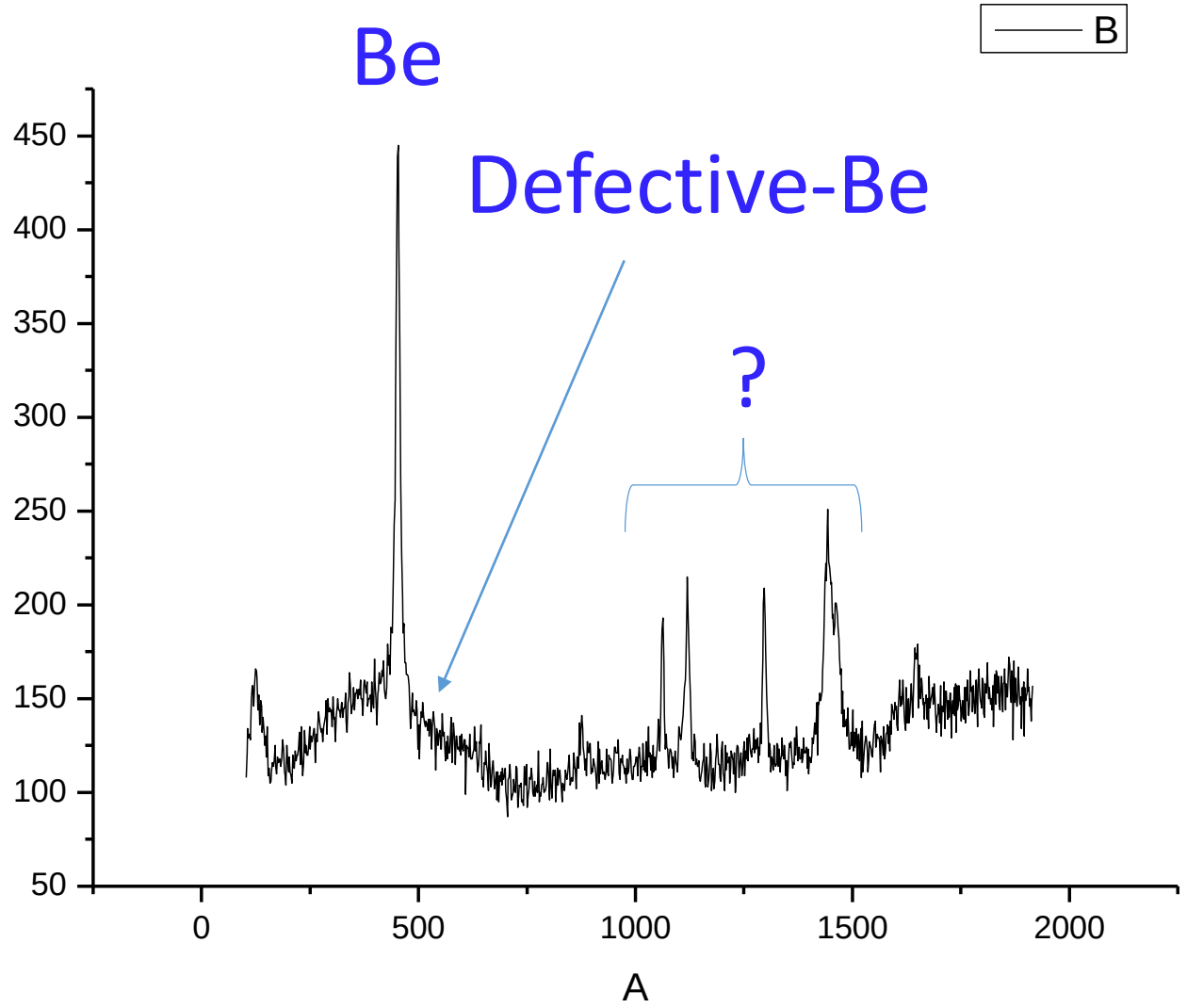
Observations: (2)

Band intensity



B





Observations: (2)

Nuclear Materials and Energy 17 (2018) 295–301

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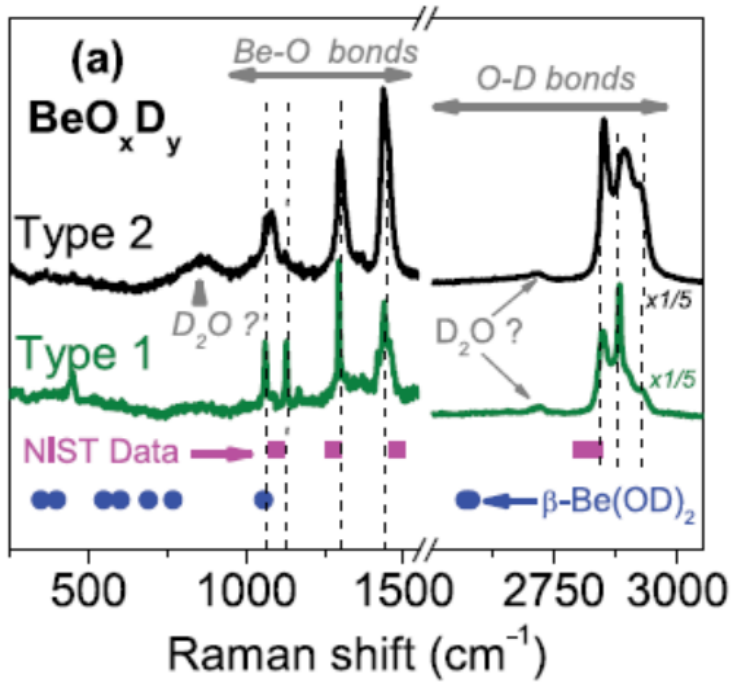
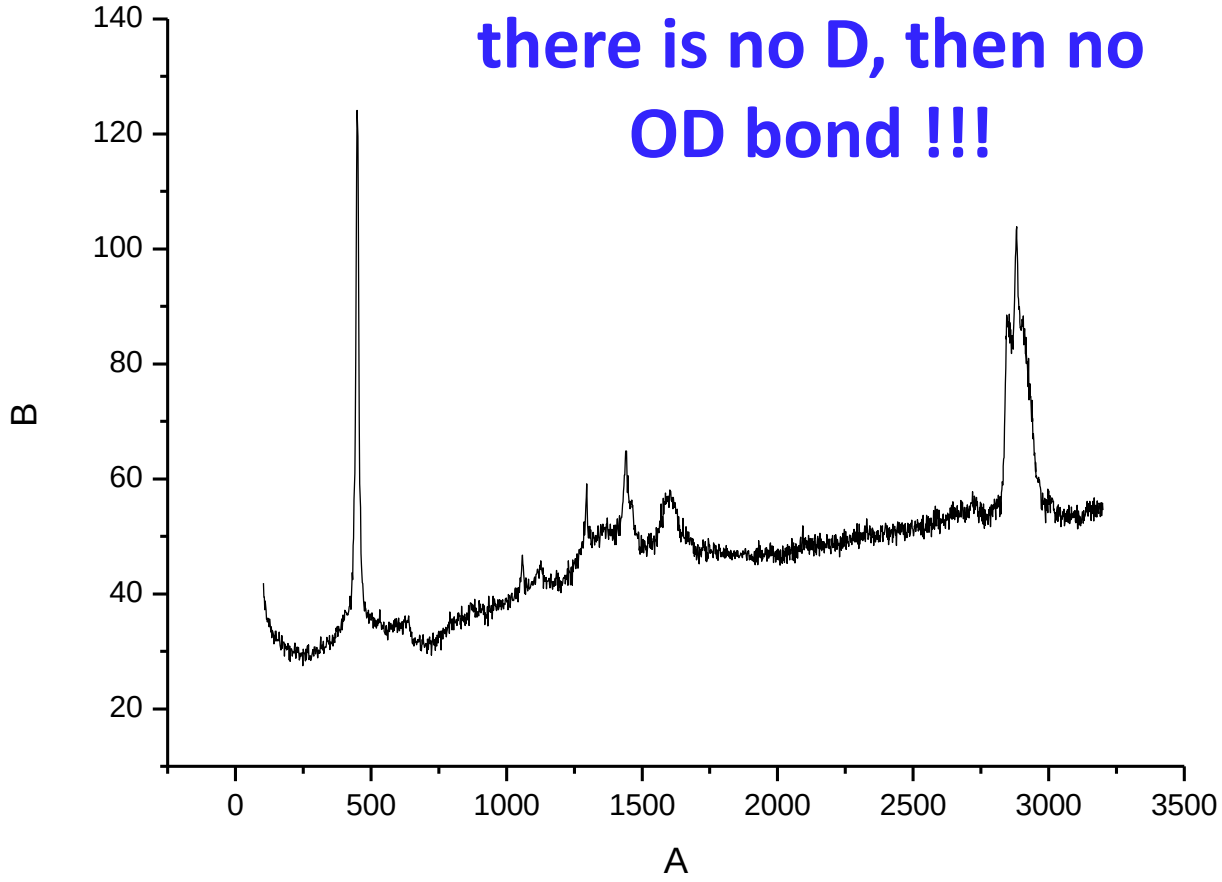
Identification of BeO and BeOxDy in melted zones of the JET Be limiter tiles: Raman study using comparison with laboratory samples

M. Kumar[a], C. Makepeace[b,f], C. Pardanaud[a,*], Y. Ferro[a], E. Hodille[a], C. Martin[a], P. Roubin[a], A. Widdowson[b], T. Dittmar[c], C.h. Linsmeier[c], C.P. Lungu[d], C. Porosnicu[d], I. Jepu[b,d], P. Dinca[d], M. Lungu[d], O.G. Pompilian[d], JET contributors[e,**]



Problem: in this sample there is no D, then no OD bond !!!



Observations: (2)

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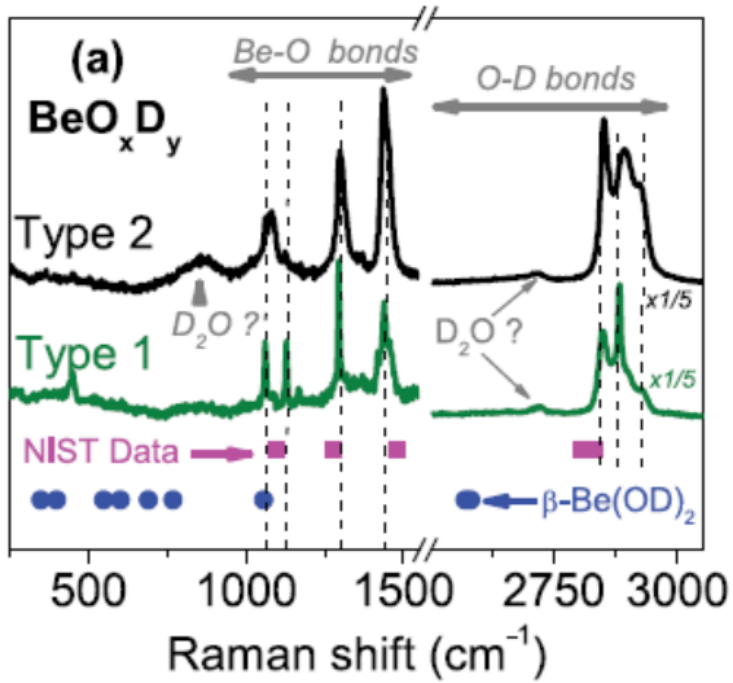

- *Bands interpreted previously to BeOD are due to fatty acid*
- *The most intense: in some parts of melted JET samples*
- *Present (traces sometimes) in romanian samples and US samples*

Question: complementarity with other SP? Science: « *Link between W and WOx* »

How to proceed? Can we think about that complementarities?

PWIE-SP-C3 Influence of He, high-flux D and impurities on Hydrogen retention

D001 Removal rate of Wox layers as function of temperature (MPG, JSI) Alexandra De Schepper (FZJ)
D002 Uptake of D through oxide films as function of temperature and thickness (MPG, JSI) Alexandra De Schepper (FZJ)
D003 Release of D through oxide films from the W bulk as function of temperature and thickness (MPG, JSI) Alexandra De Schepper (FZJ)
D004 Removal rate of Wox layers as function of temperature (MPG, JSI) Janez Zavasnik (JSI)
D005 Uptake of D through oxide films as function of temperature and thickness (MPG, JSI) Janez Zavasnik (JSI)

Tasks to be performed:

Reduction and removal of surface oxide films from W by deuterium plasma (MPG)
Influence of surface oxide films on the uptake of deuterium into the metallic tungsten in dependence of the oxide film thickness (MPG)
Influence of surface oxide films on the release of deuterium into the metallic tungsten in dependence of the oxide film thickness (MPG)
XRD and **Raman** of **Oxide** films on W in cooperation with MPG (JSI, MPG)
Comparing He cluster nucleation in defect free and e-beam-damaged W (MPG)
E-beam irradiation of single crystal W from MPG (ENEA)
Influence of surface microstructure due to low energy He irradiation on D uptake studied in situ (JSI, MG)
Self-damaged W samples for JSI investigation (MPG)