

Analysis of boron layers (thermal evolution, atmospheric evolution,...)

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Samples

Romania (BD with RT, 50,100,...400,450,500°C)

Uppsala

Milano

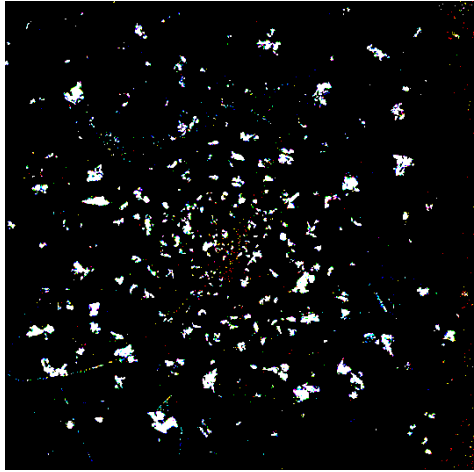
Techniques

Raman (of course)

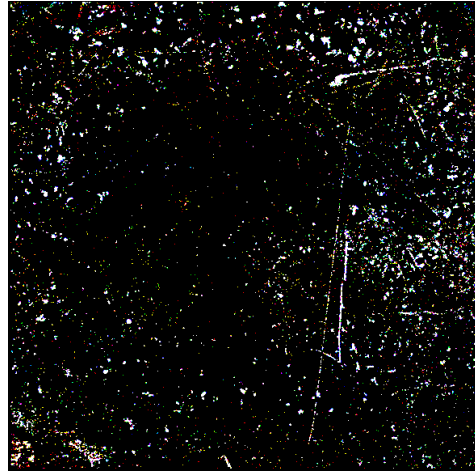
Optical microscopy

Confocal microscopy *(Bag opened: 16th of may, measurement done on 5th of june)*

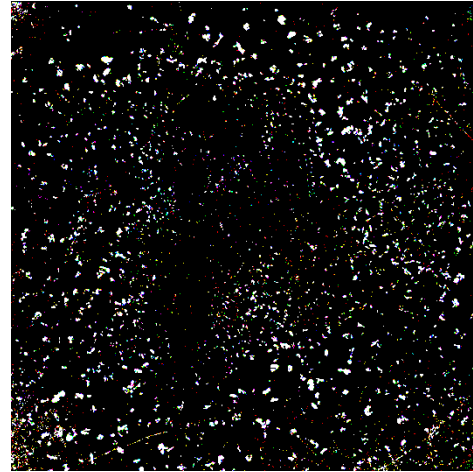
RT



50°C



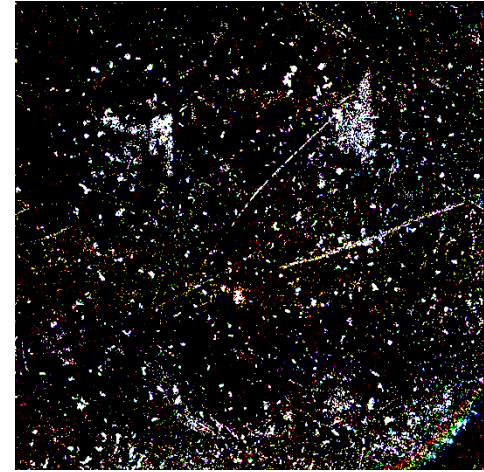
100°C



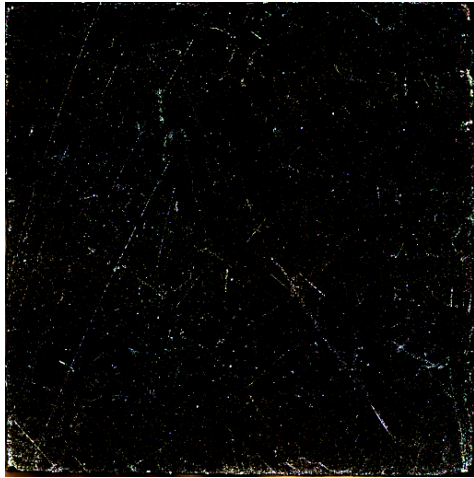
150°C



200°C



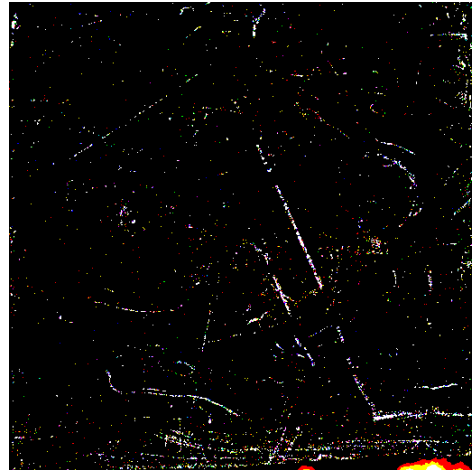
300°C



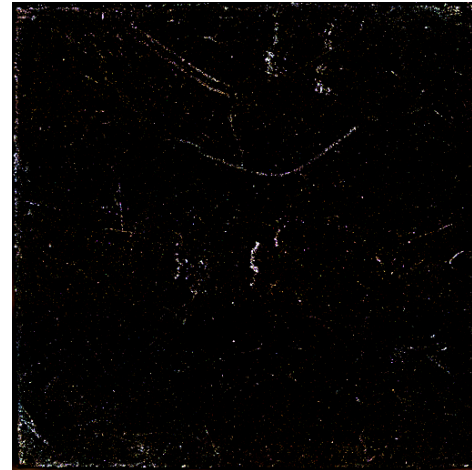
350°C



400°C



450°C

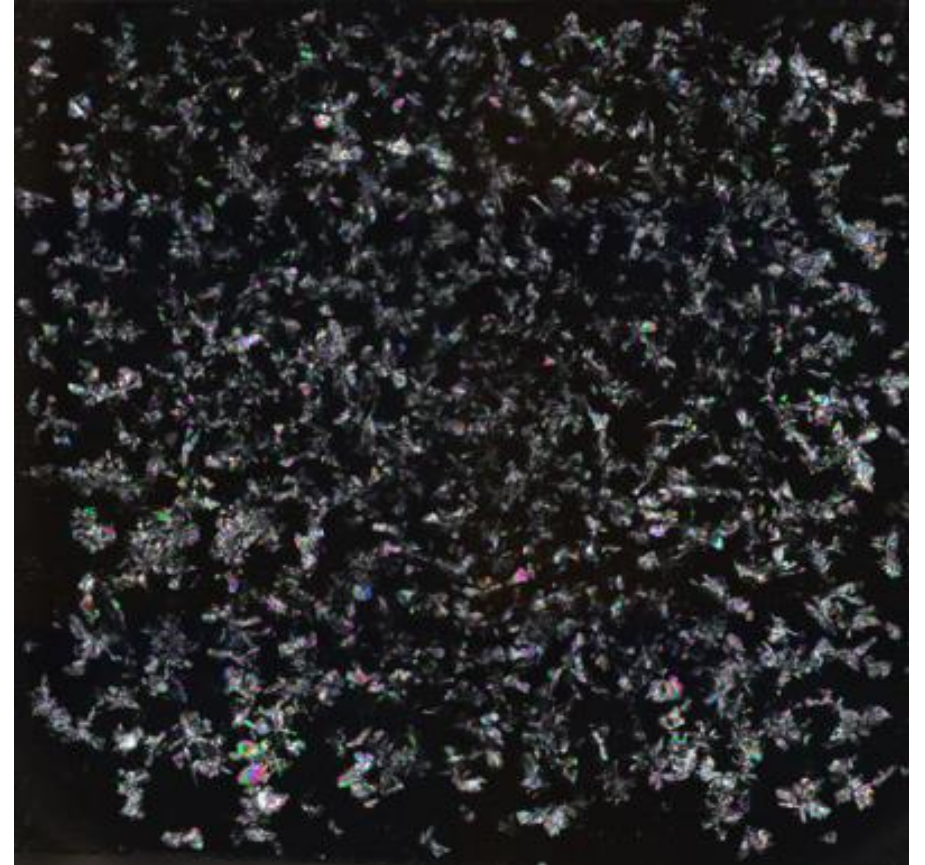
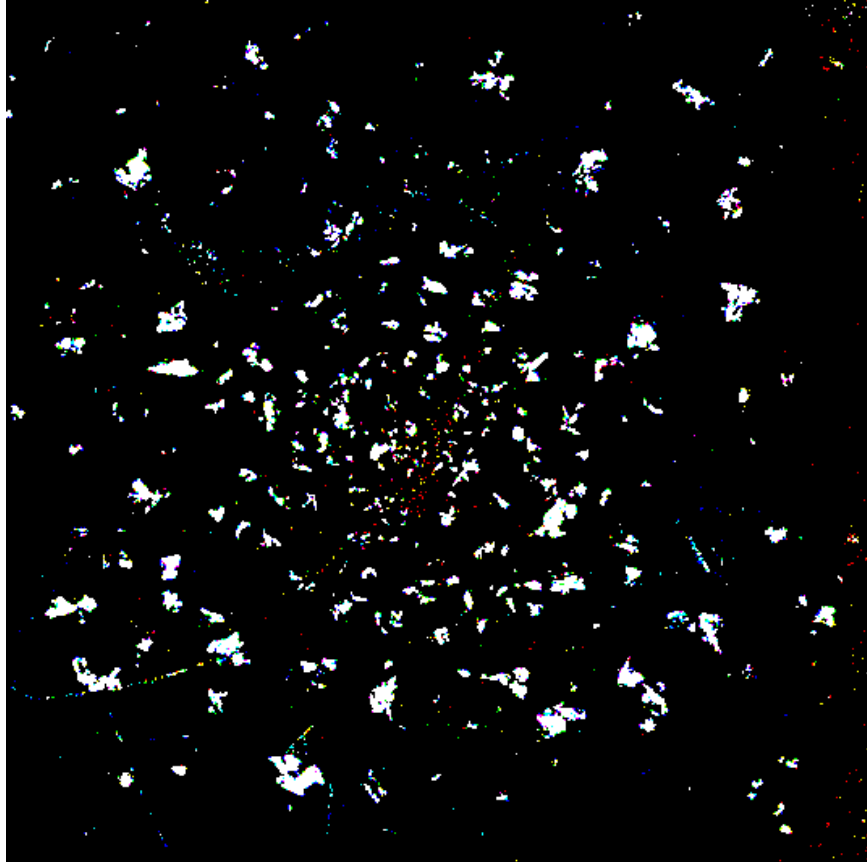


500°C



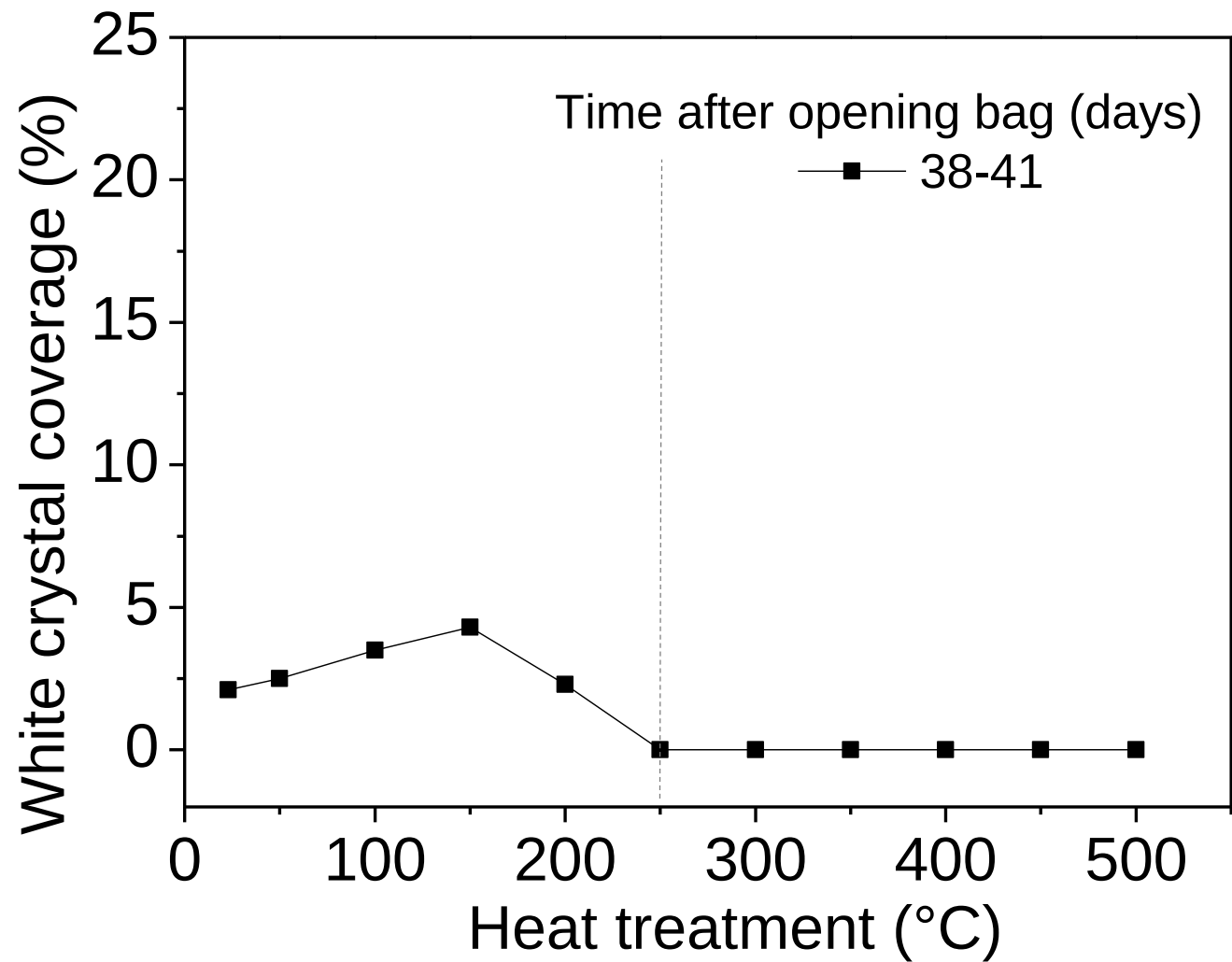
White crystal found for $T < 200^{\circ}\text{C}$ ≈ 1 month after opening the bags

Confocal microscopy

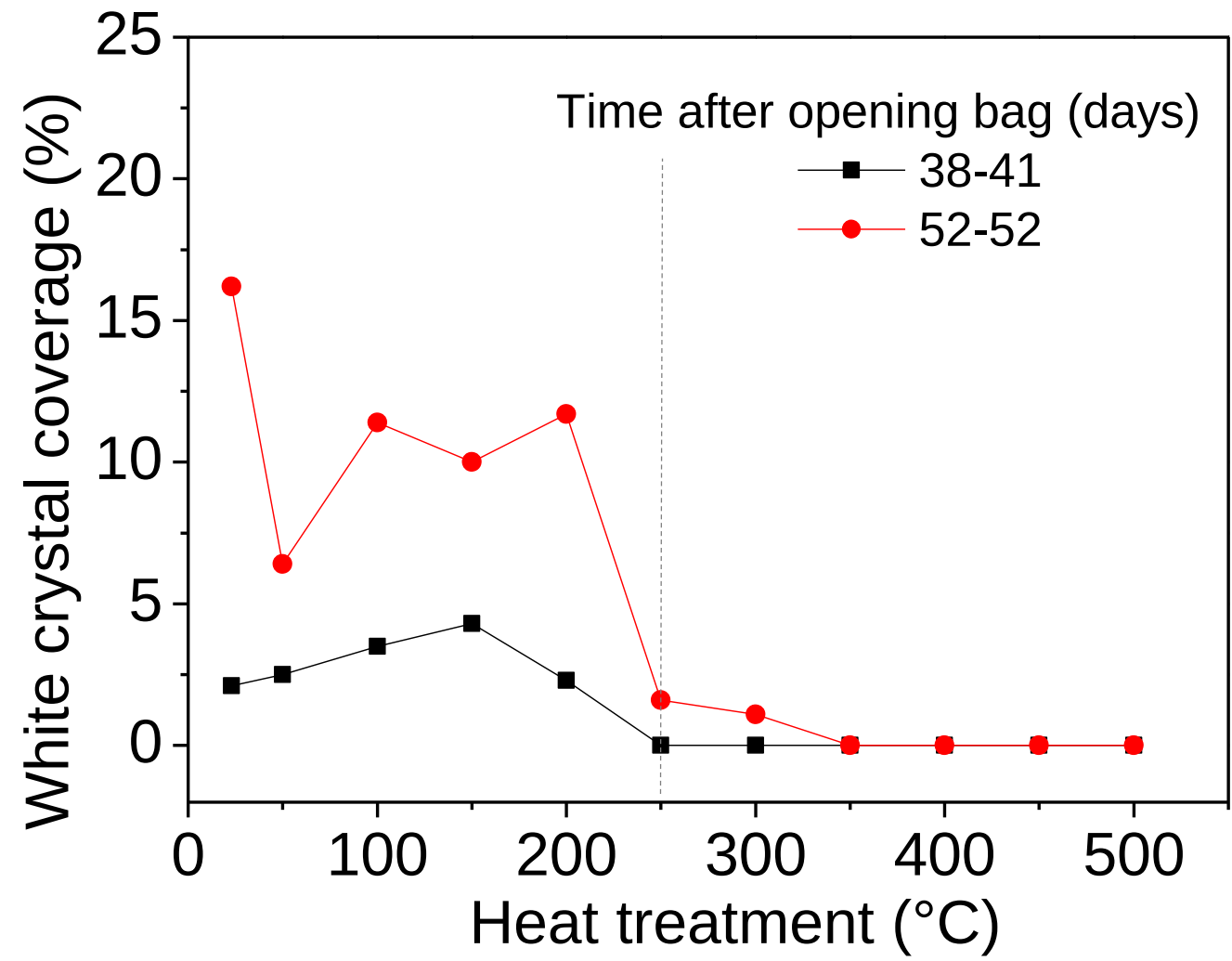


These white crystals evolve quickly with time but it seems to depend on post heattreatment

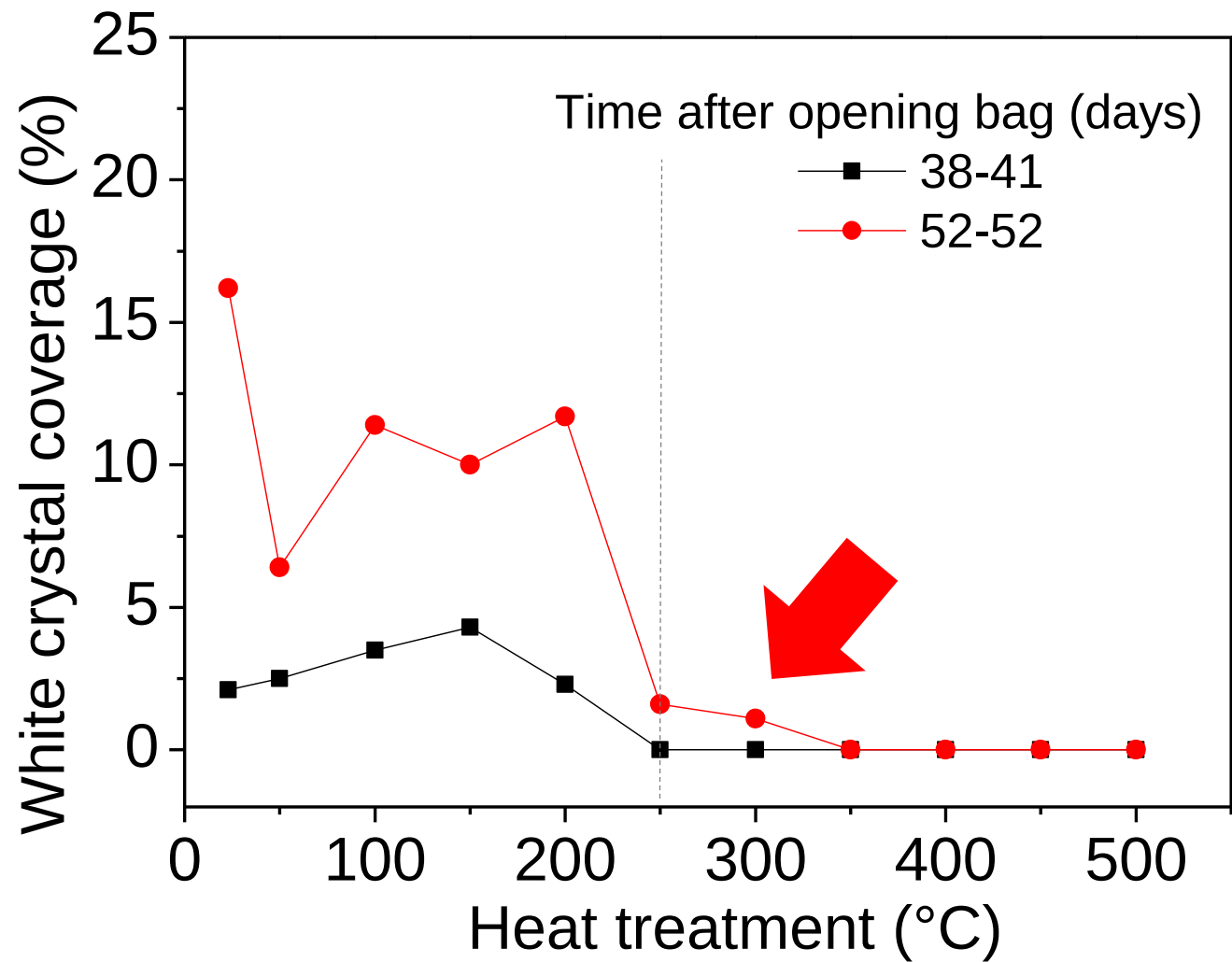
Confocal microscopy



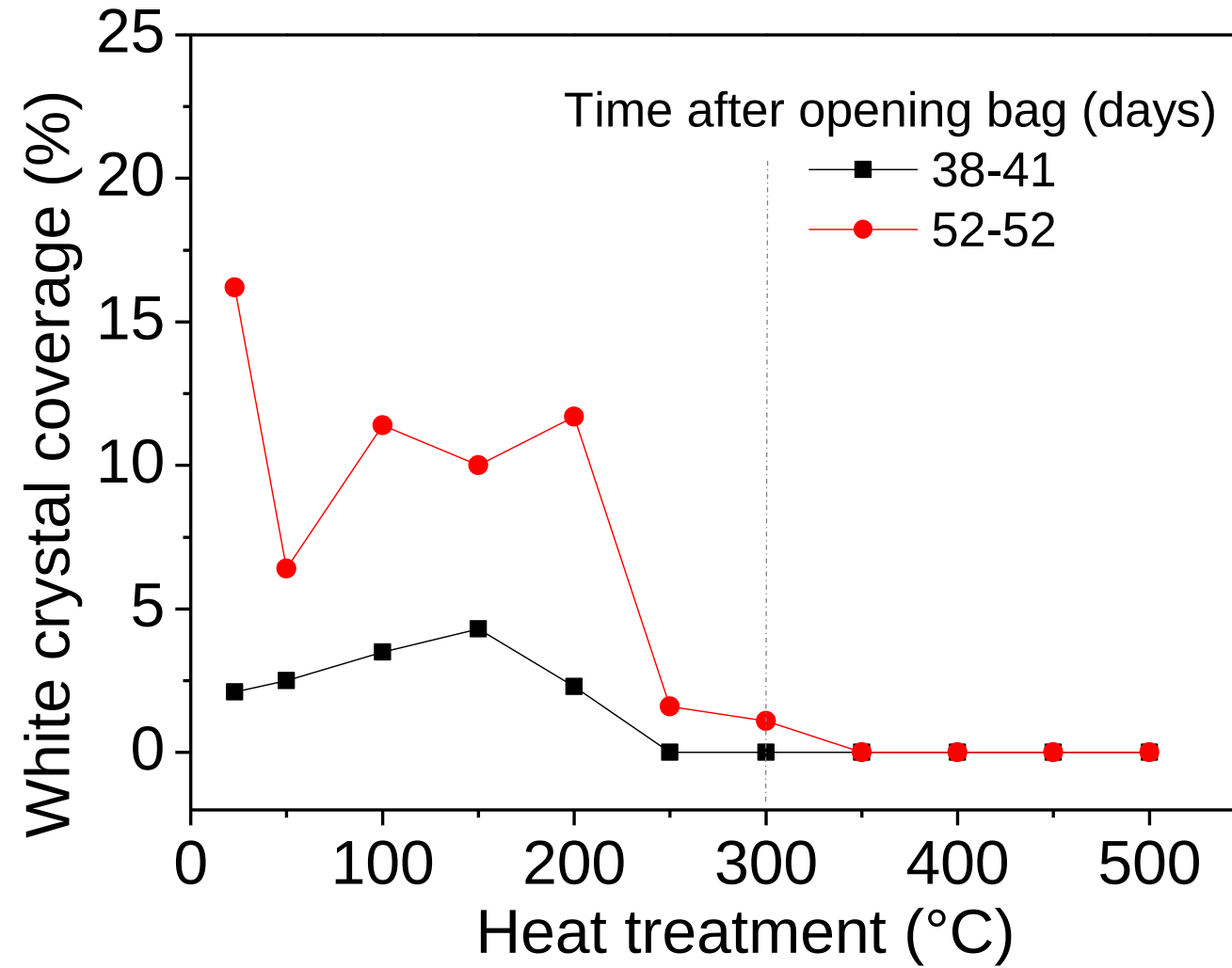
Confocal microscopy



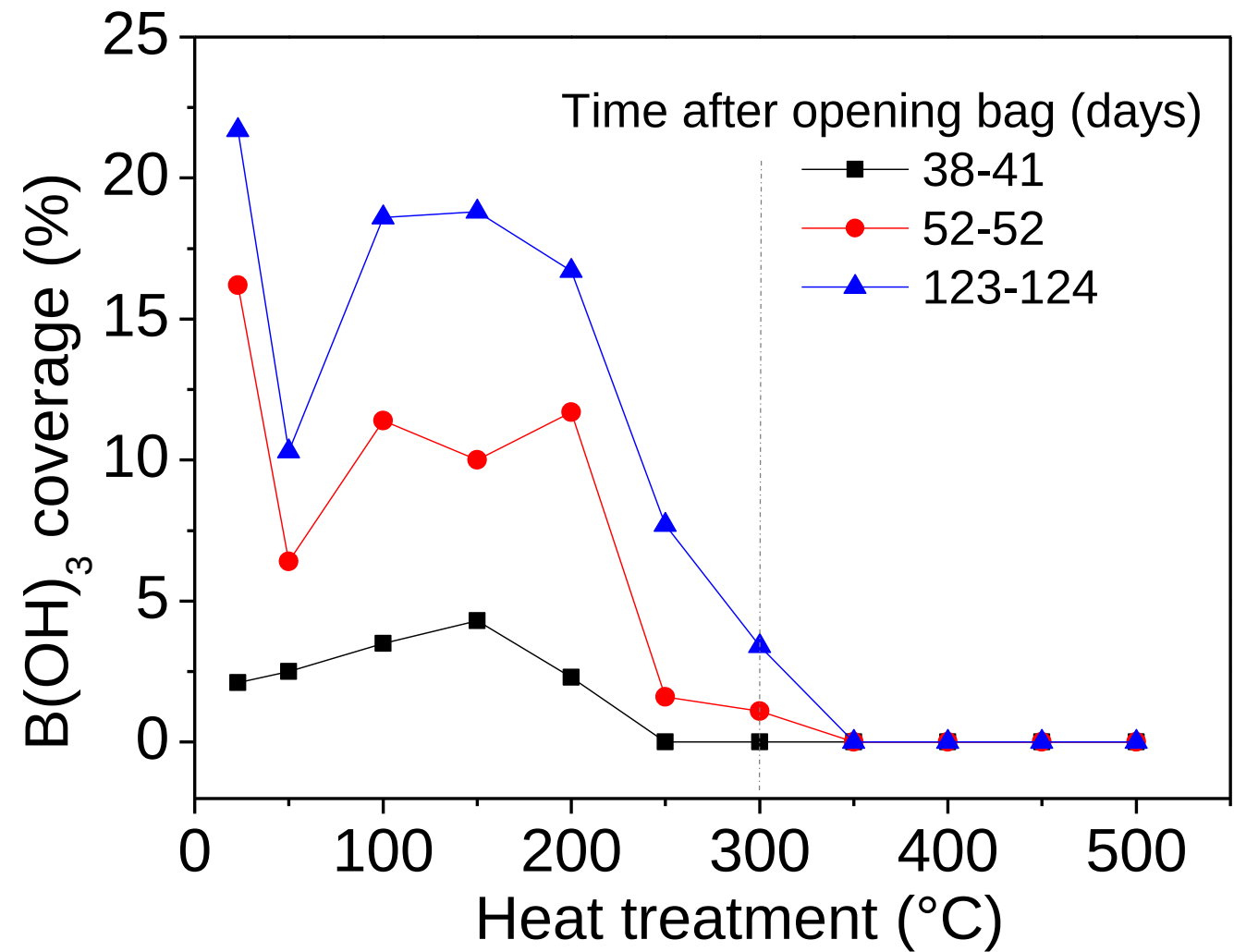
Confocal microscopy



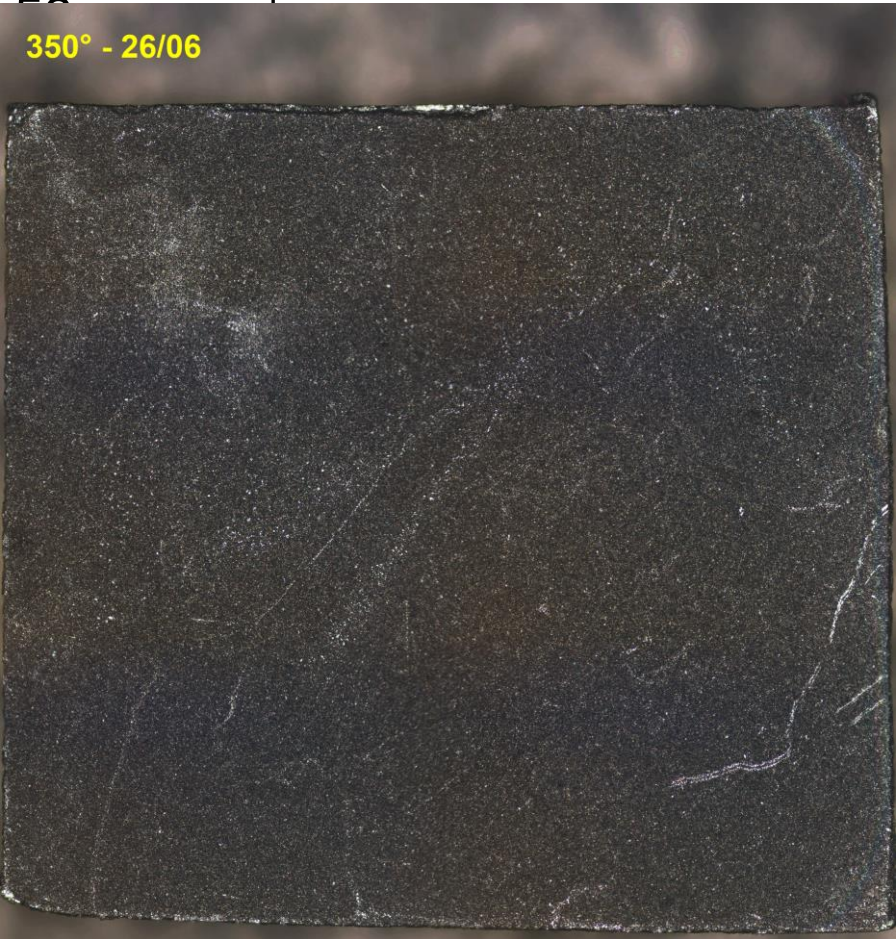
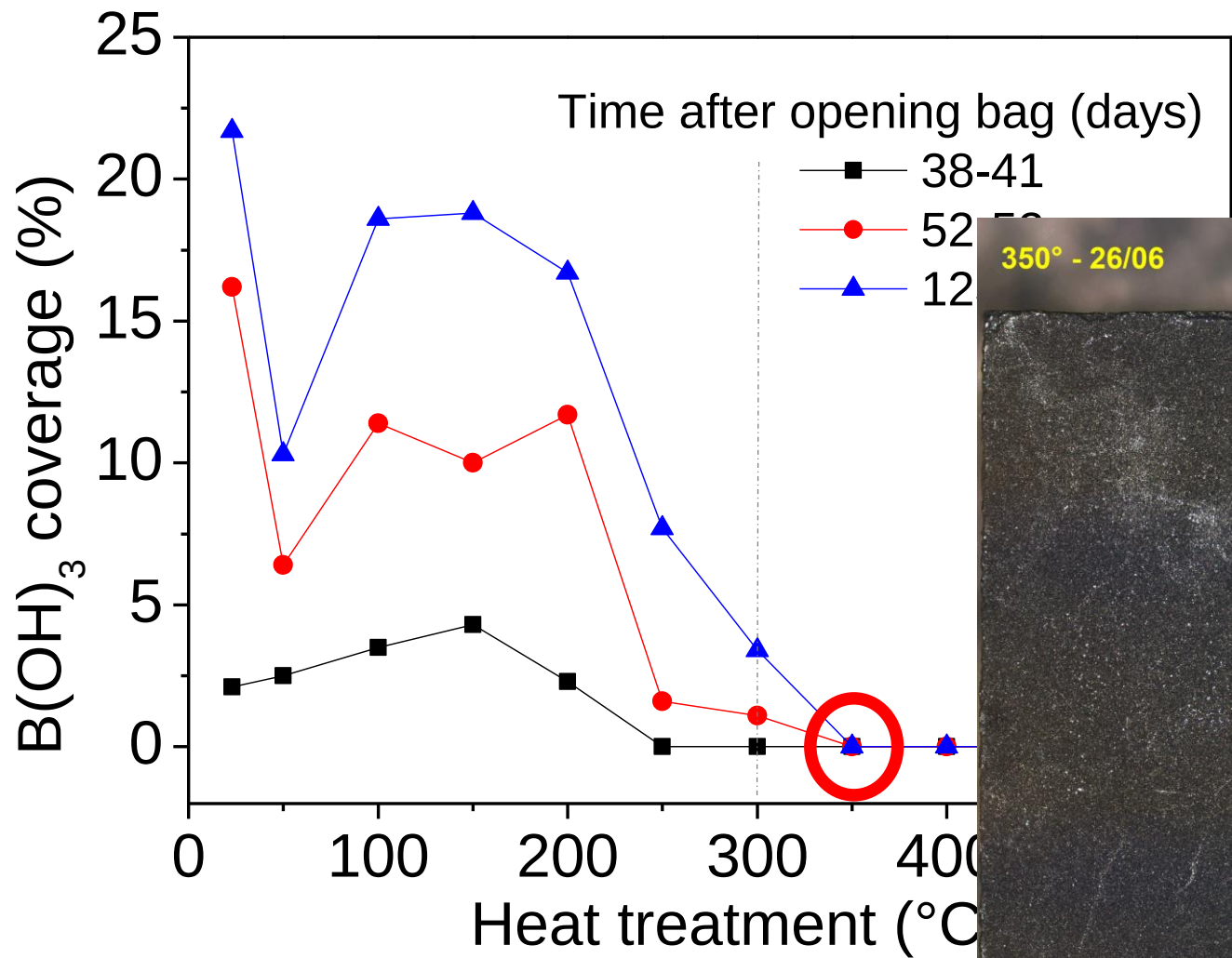
Confocal microscopy



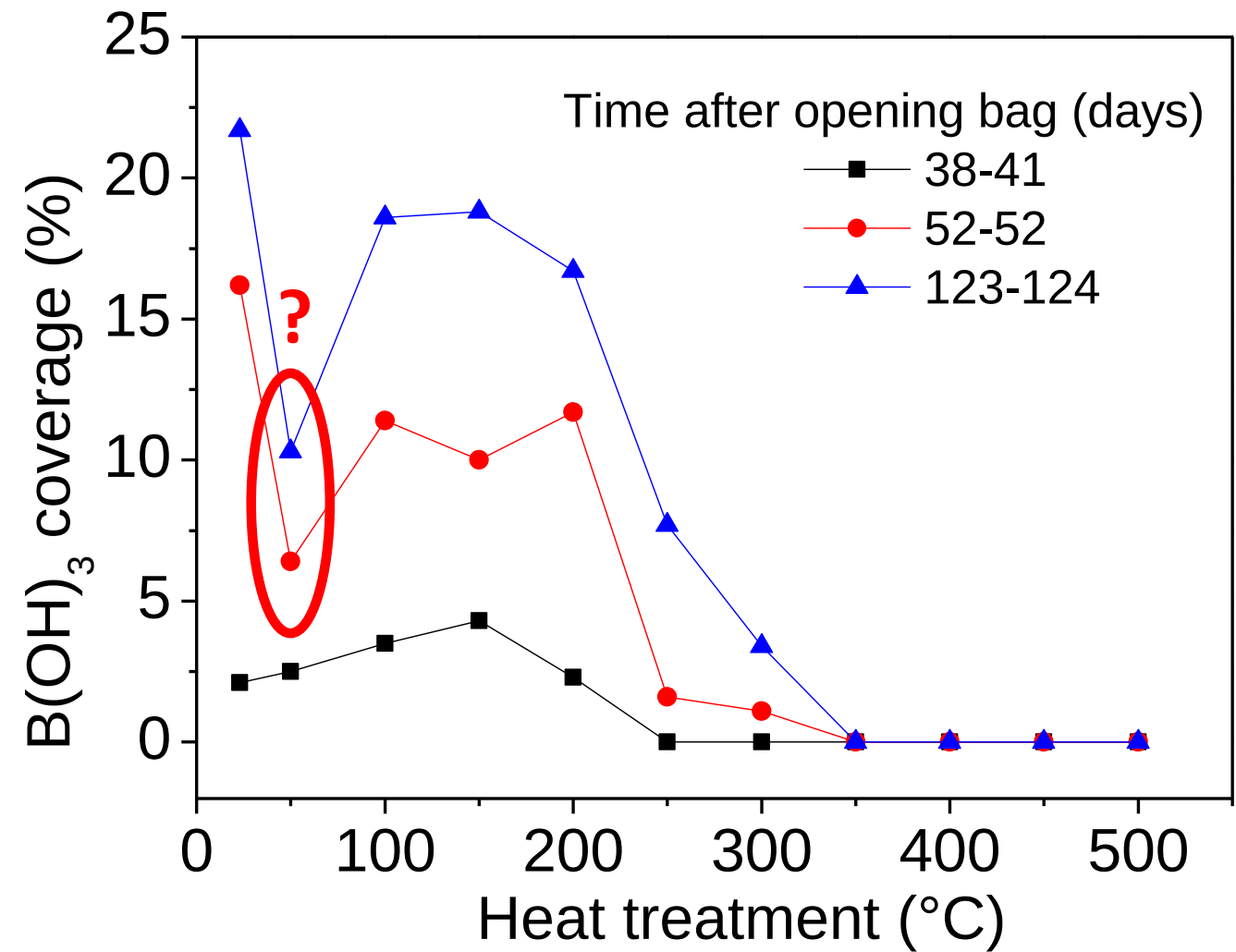
Confocal microscopy



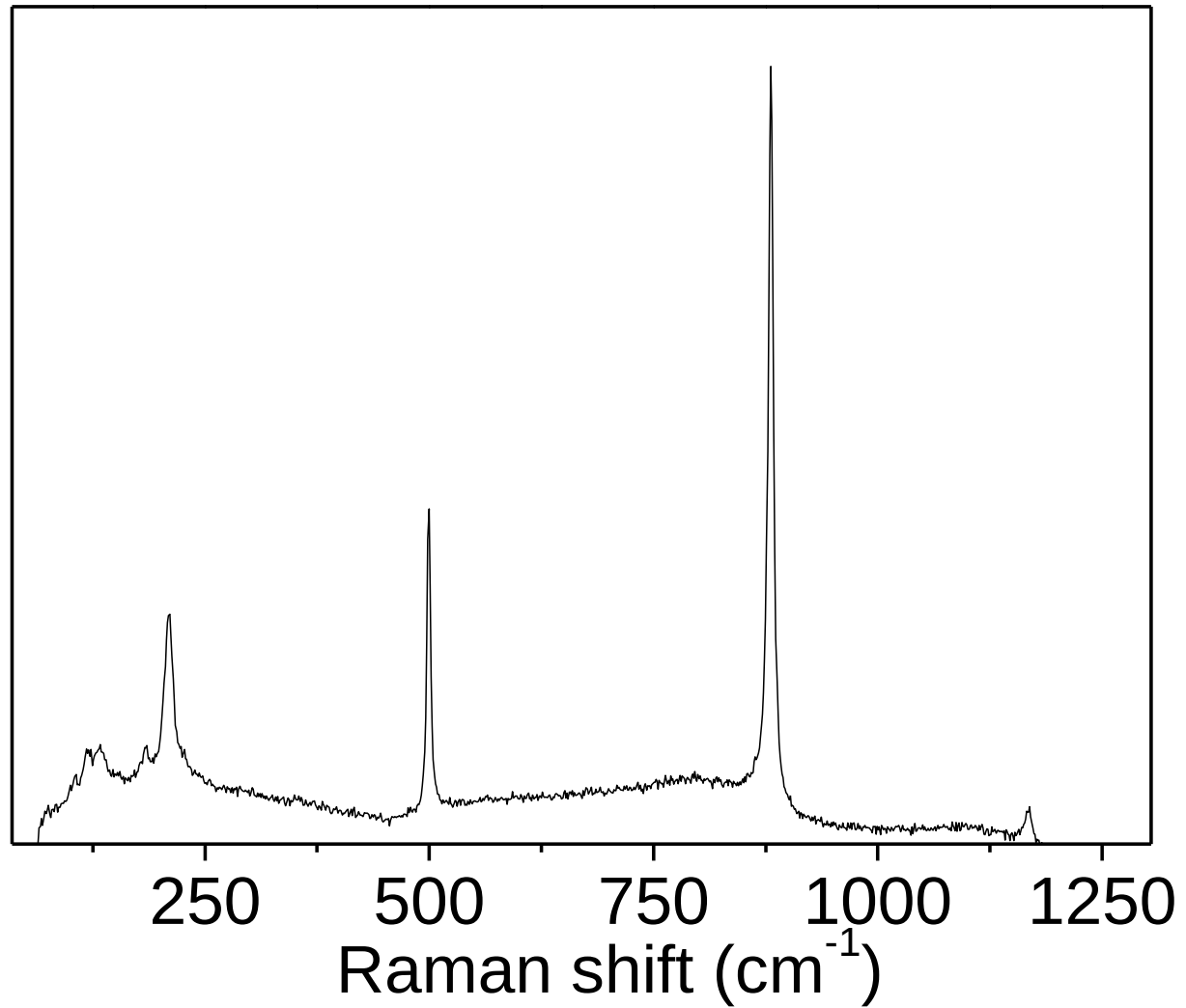
Confocal microscopy



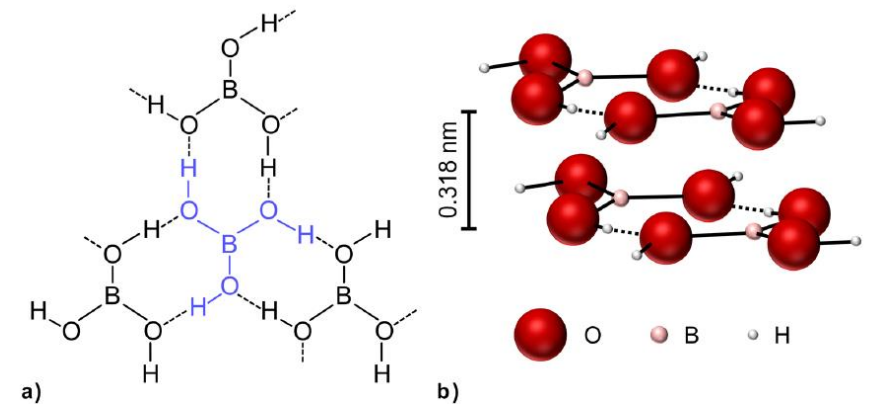
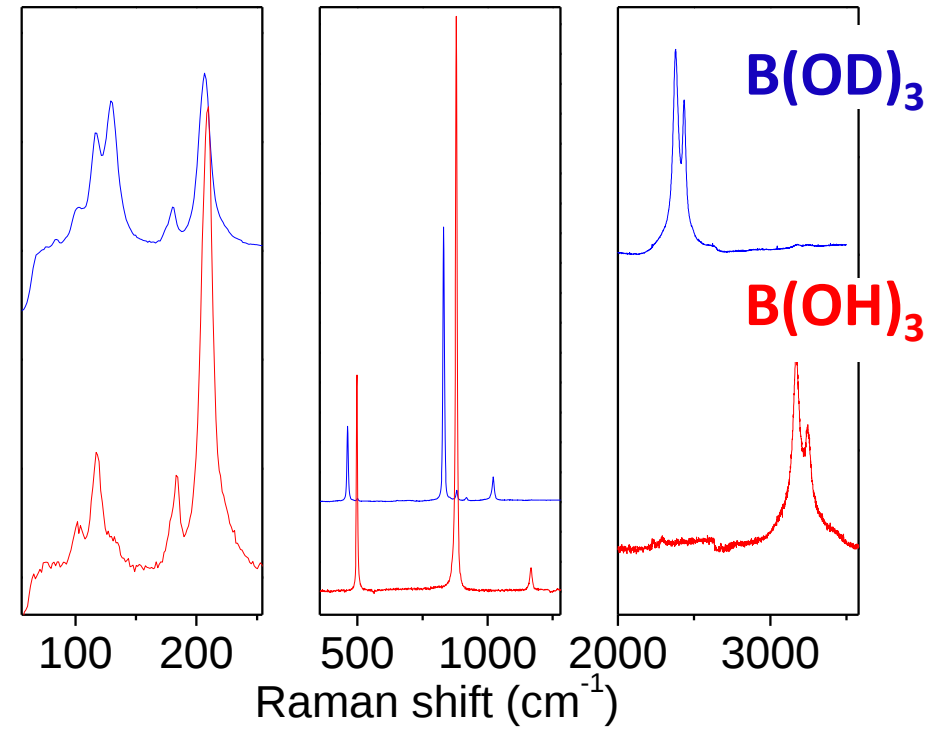
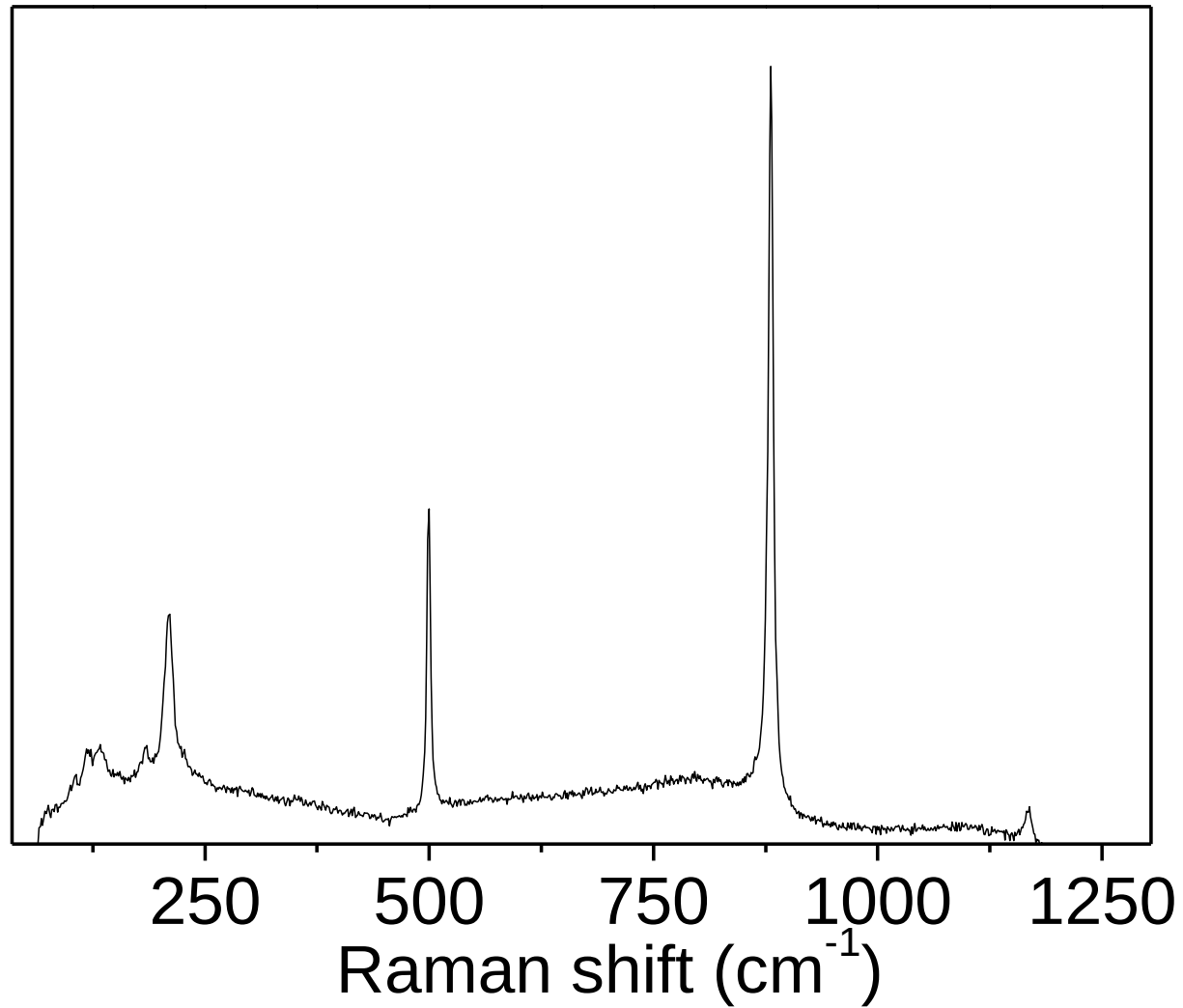
Confocal microscopy



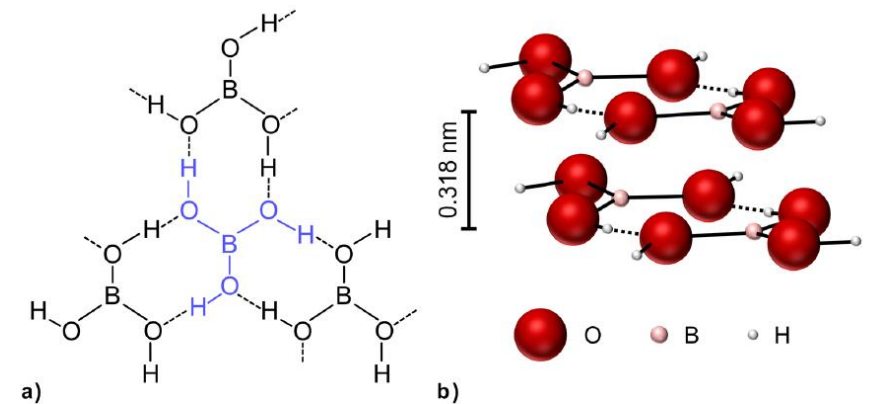
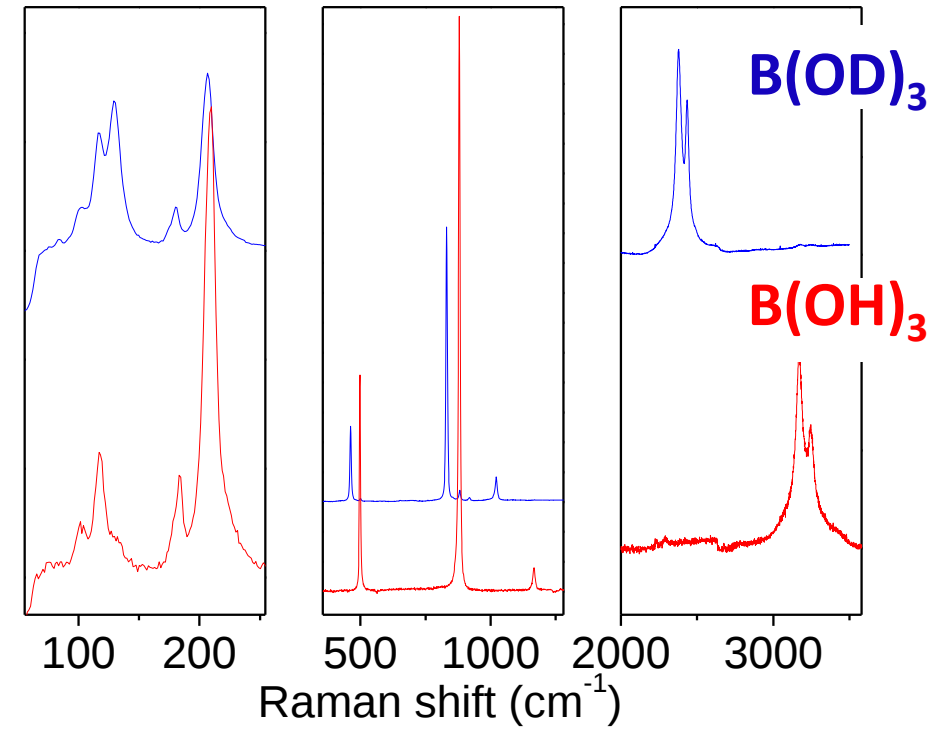
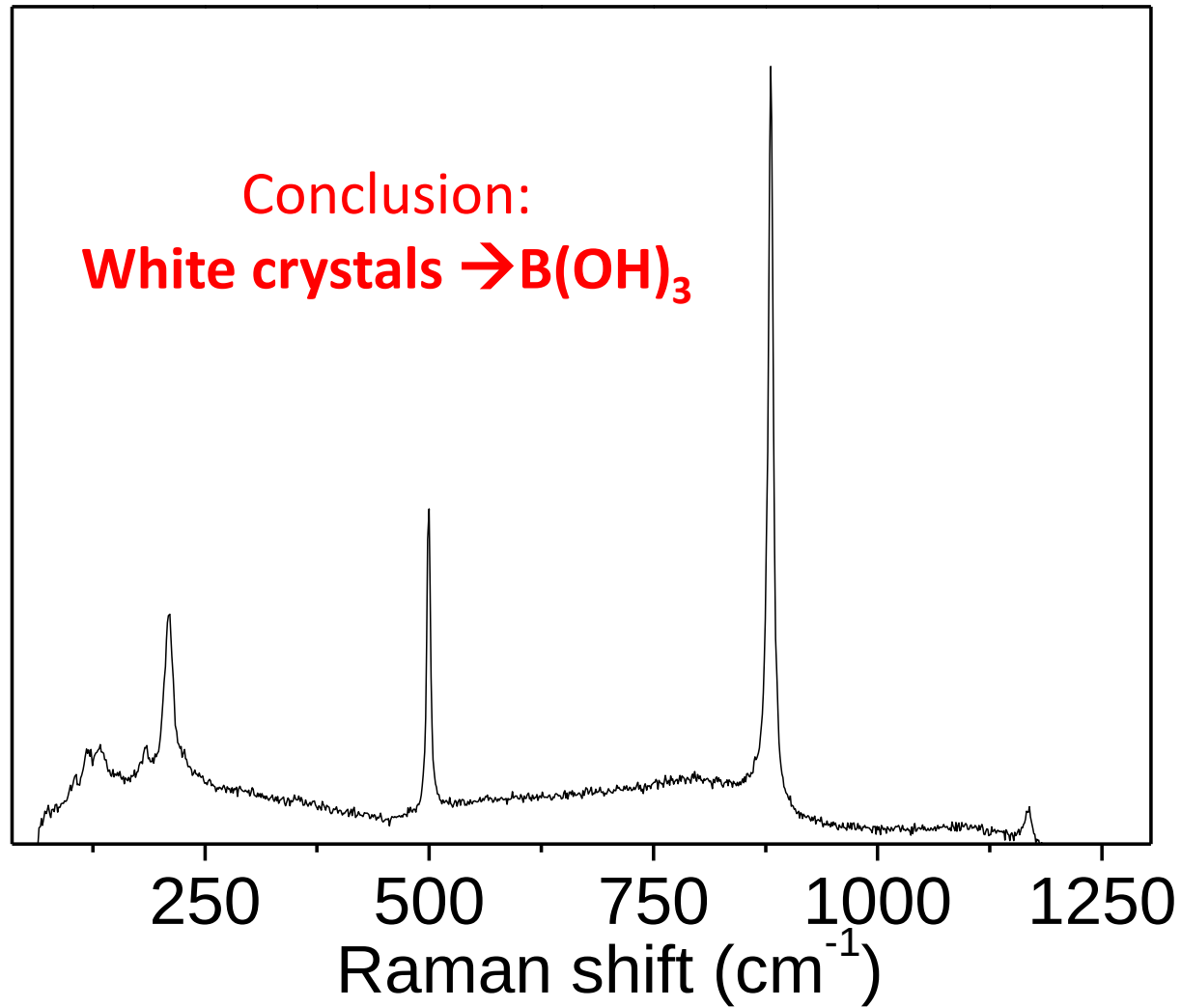
Raman microscopy (on white zones)



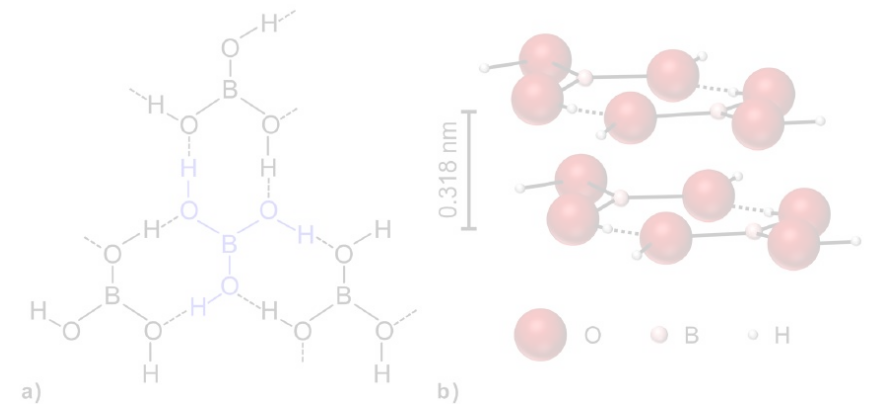
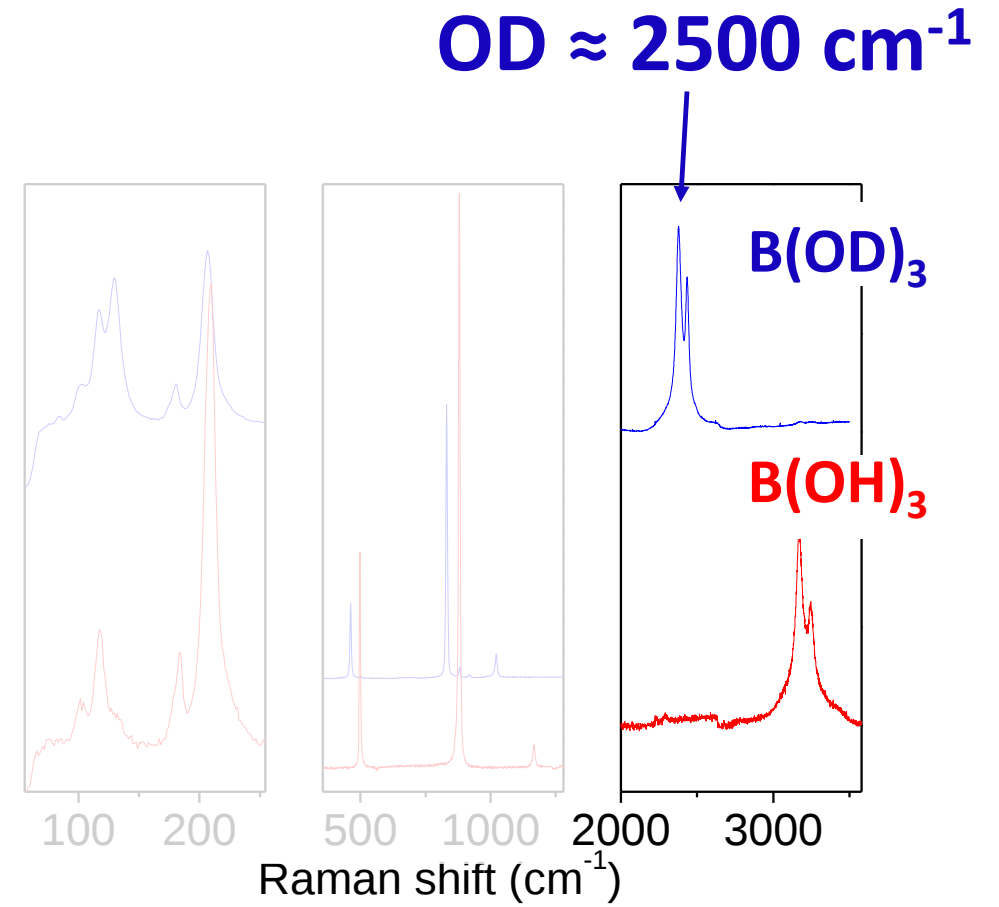
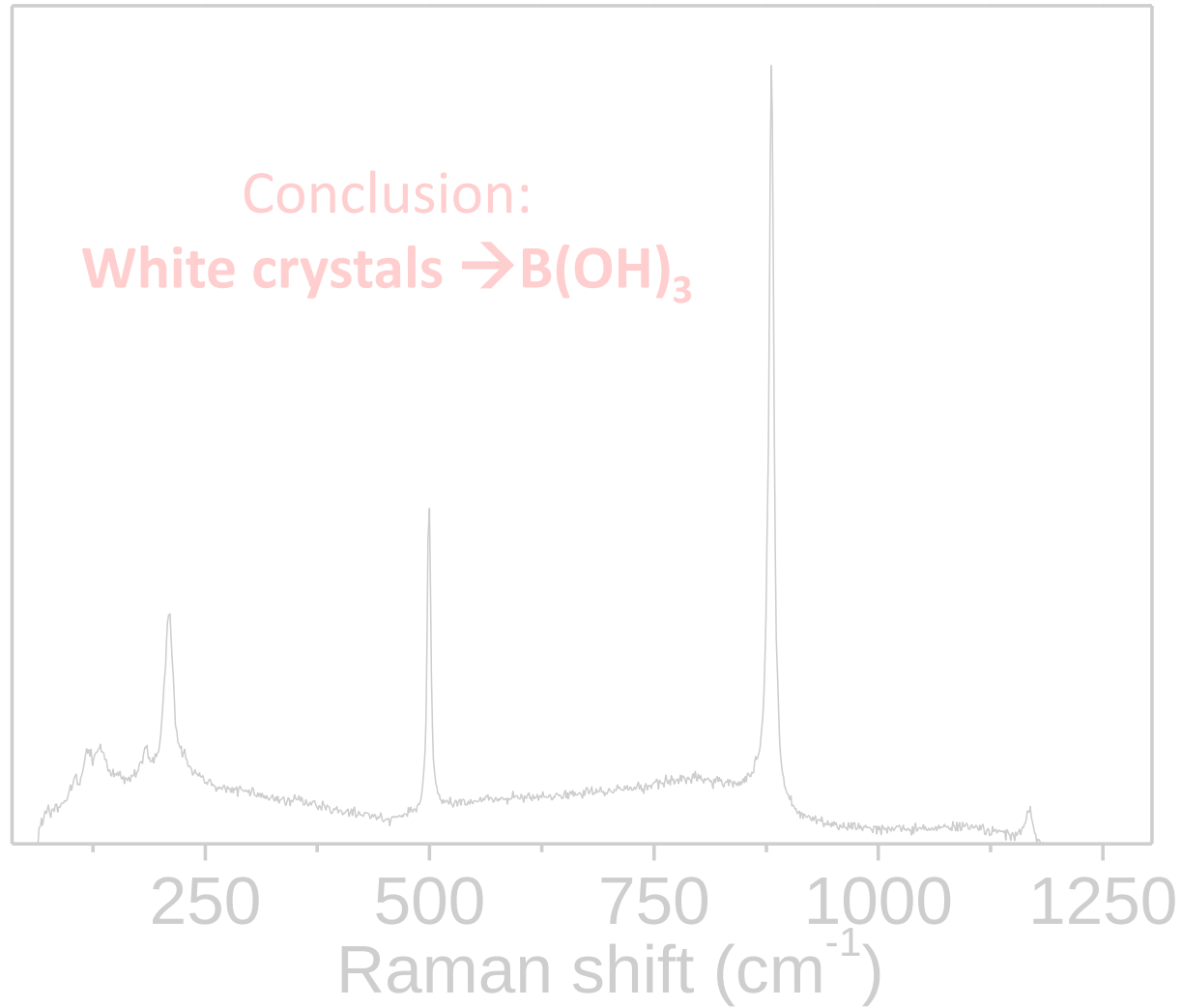
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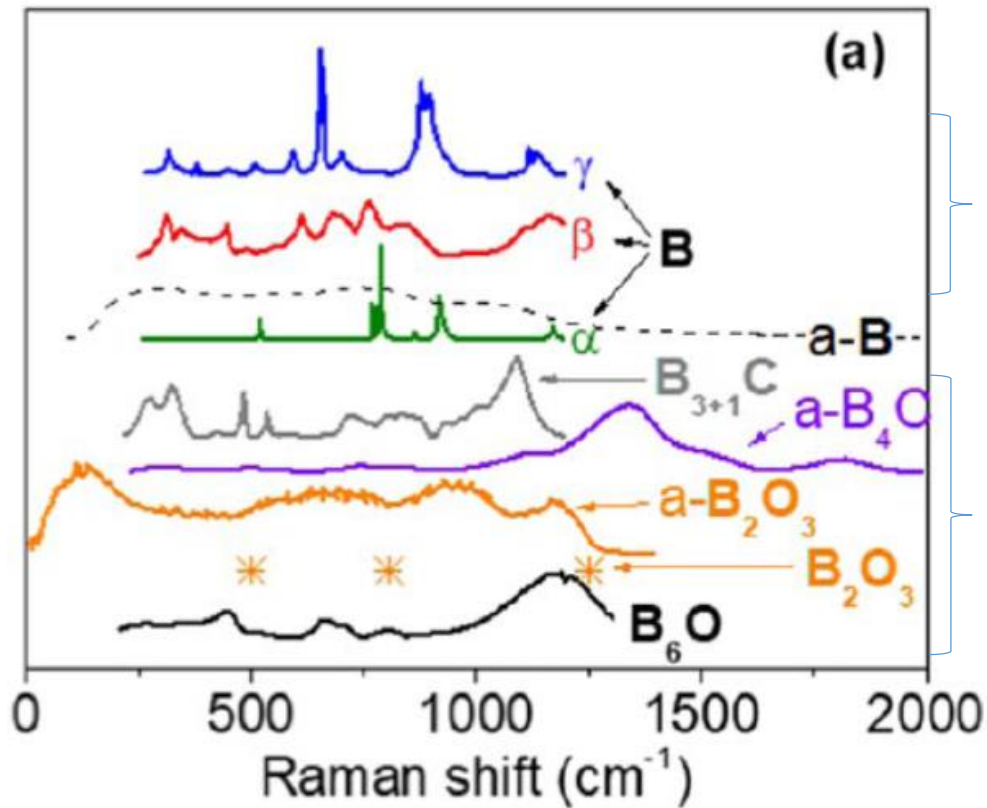
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Raman microscopy (on white zones)



Raman microscopy of borons

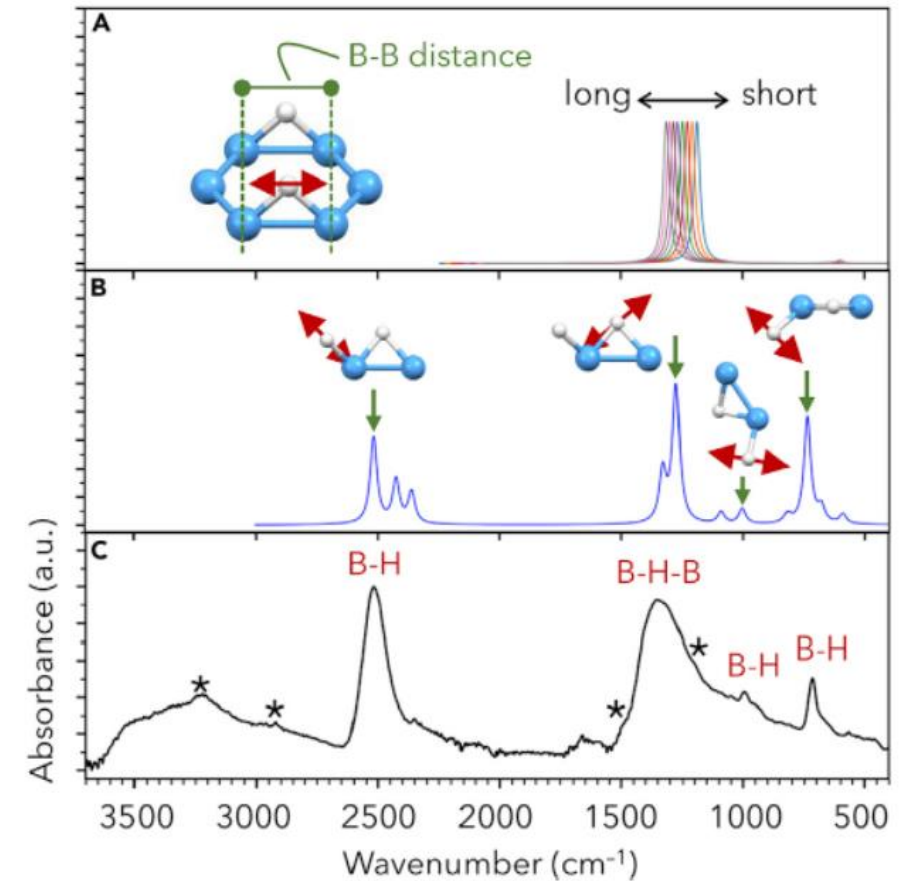


crystals
amorphous

alloys

aBH

IR spectro



Mater. Res. Express 10 (2023) 102003

Materials Research Express
TOPICAL REVIEW

Raman microscopy to characterize plasma-wall interaction
materials: from carbon era to metallic walls

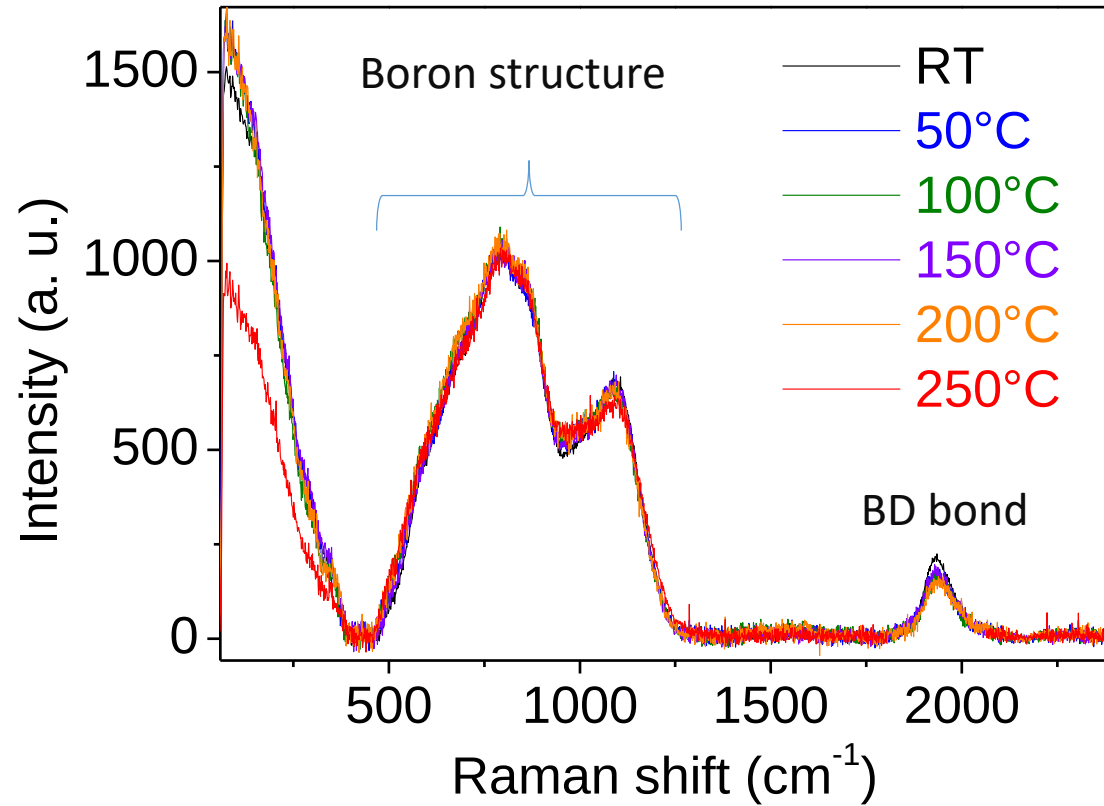
C Pardanaud^{1,*}, C Martin¹, P Roubin¹, G Roussin¹, D Dellasega^{2,3}, M Passoni^{2,3}, C Lungu⁴,
C Porosnicu⁴, P Dinca⁴, I Bogdanović Radović⁵, Z Siketić⁵, B Pégourié⁶, E Bernard⁶, M Diez⁶, A Hakola⁷
EUROfusion WP PFC contributors⁸

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<https://doi.org/10.1016/j.chempr.2019.11.006>

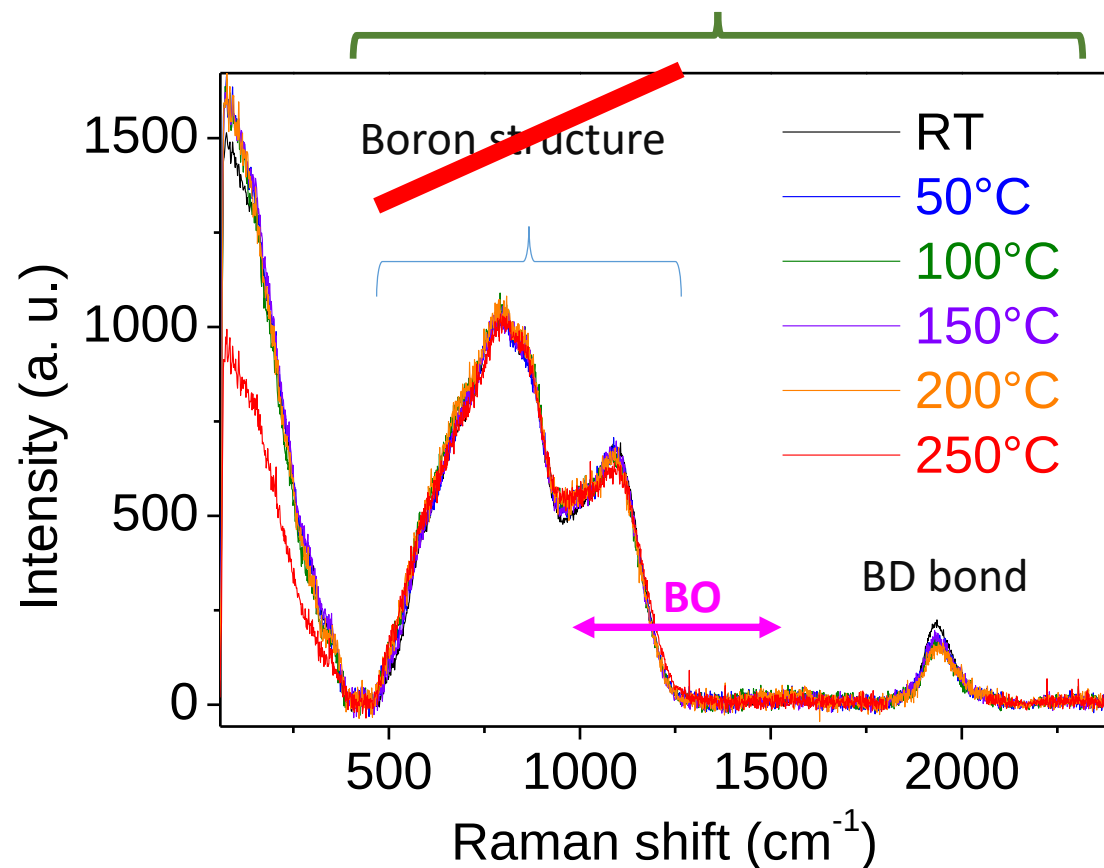
Raman microscopy (out of white zones)



Below 250°C: boron structure stays stable

Raman microscopy (out of white zones)

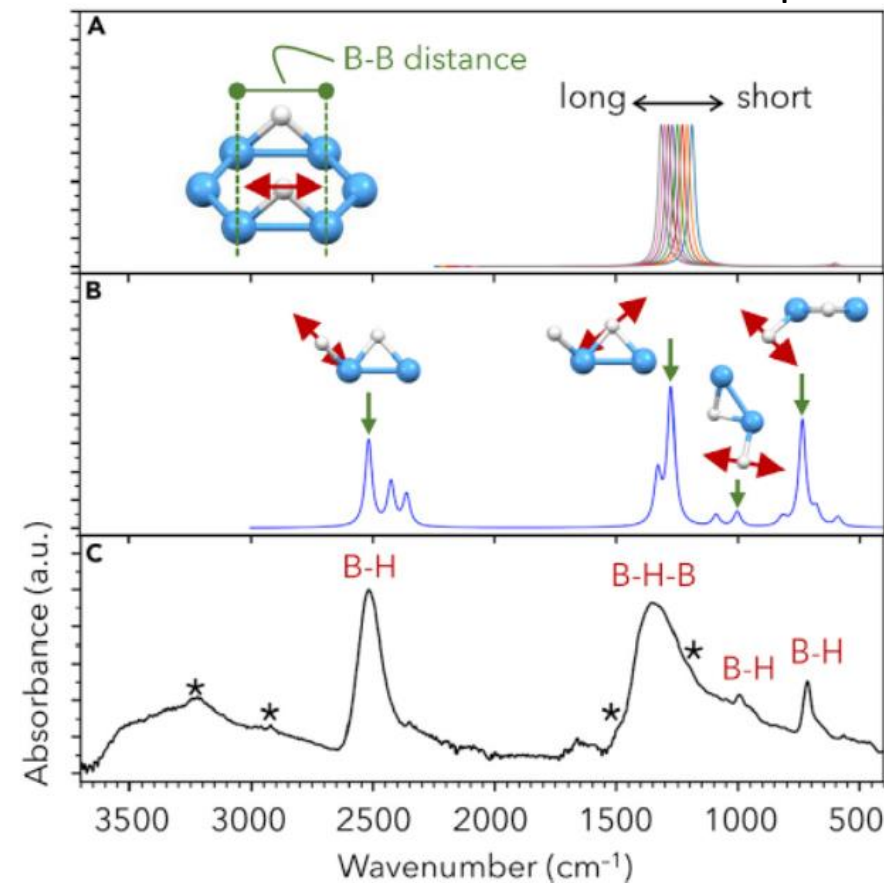
All B-D related modes



Below 250°C: boron structure stays stable

aBH

IR spectro

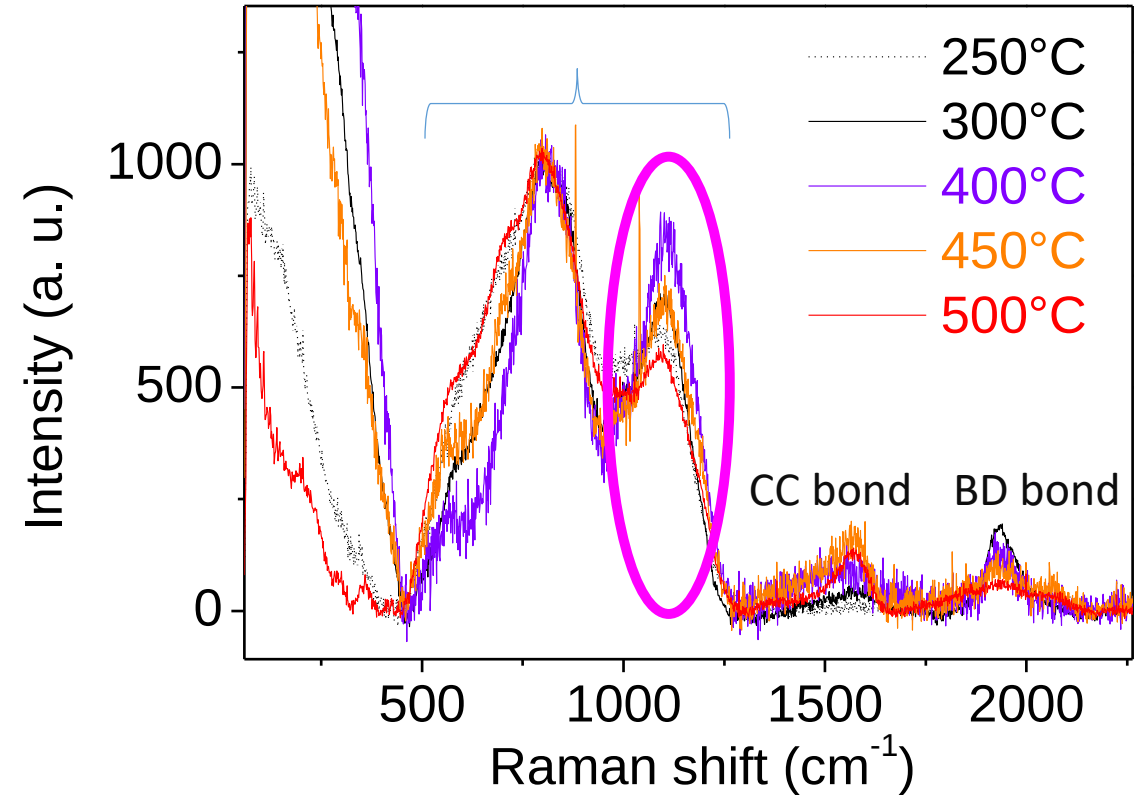
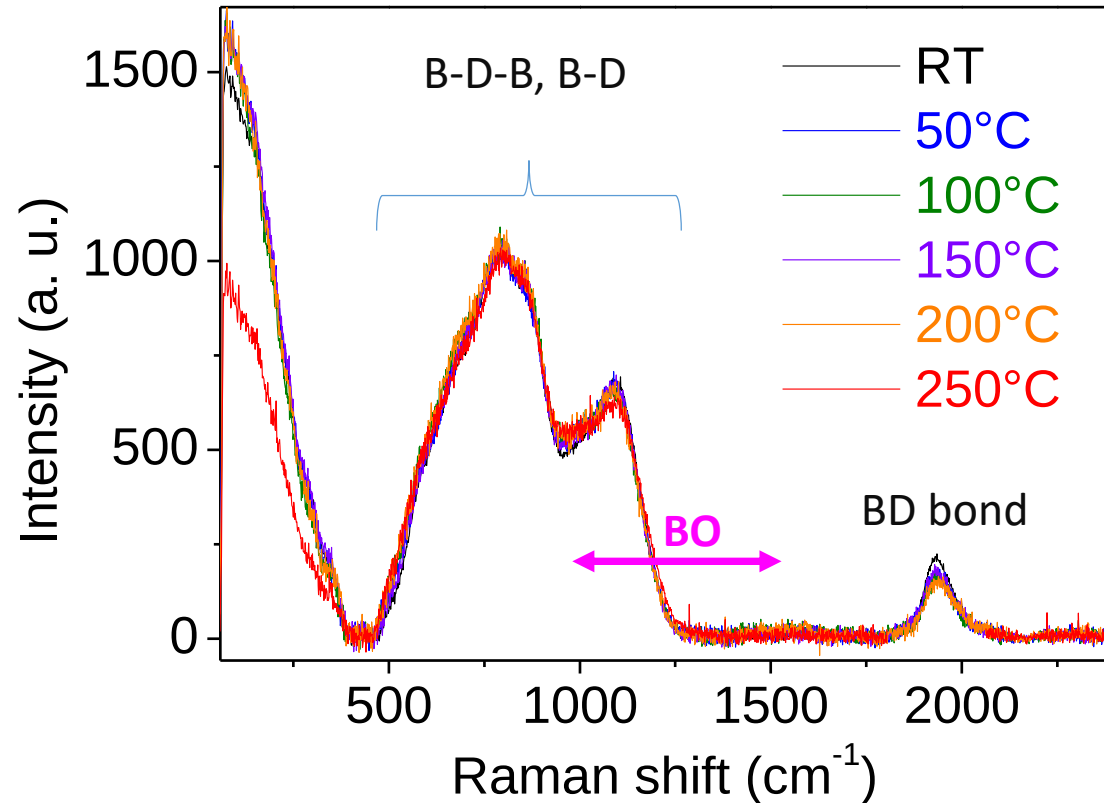


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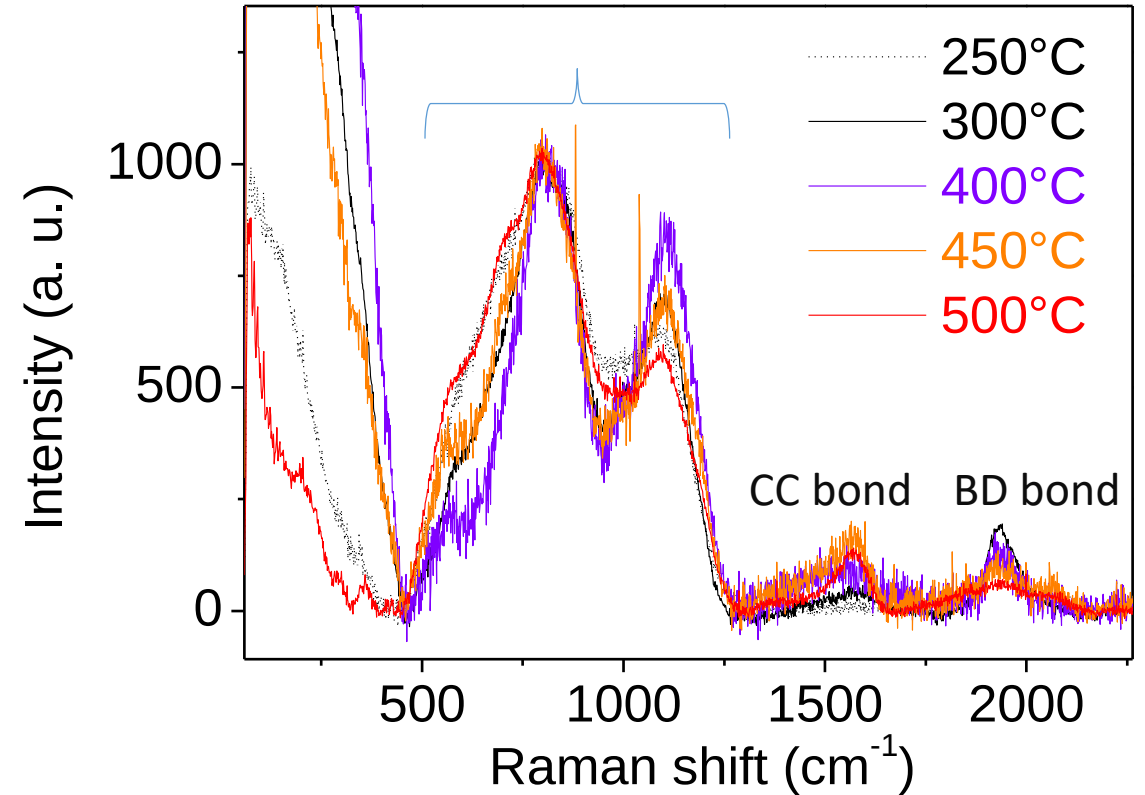
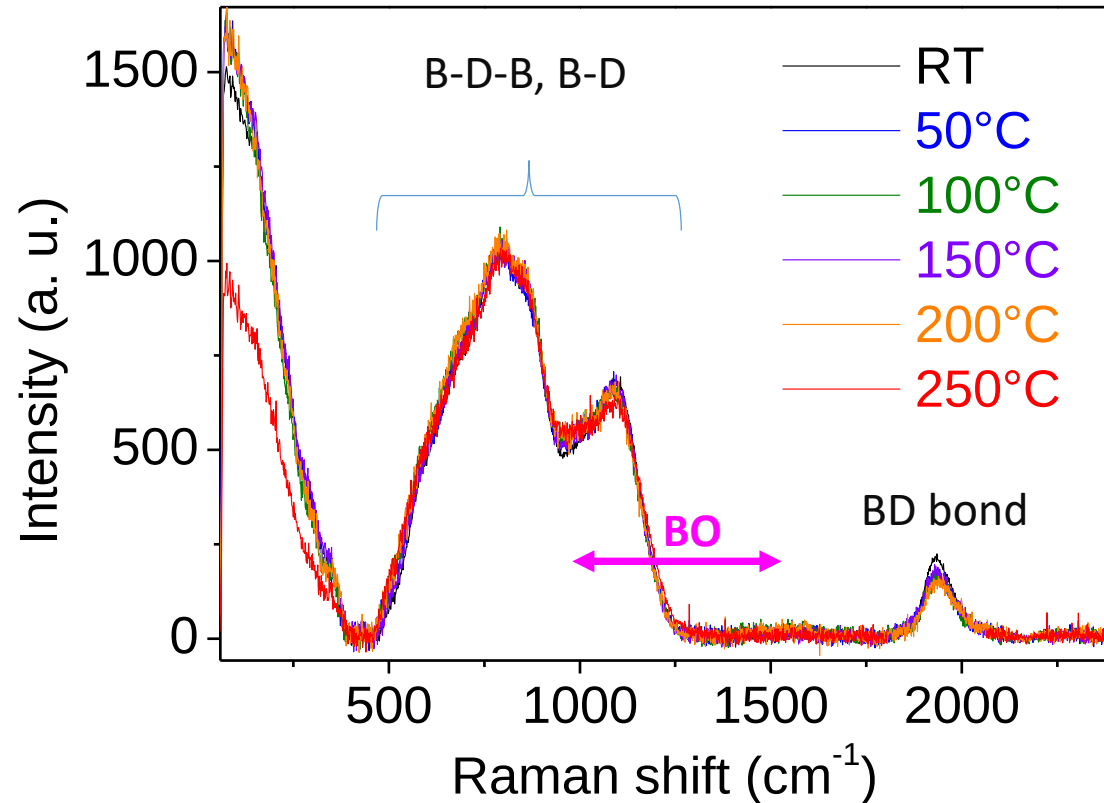
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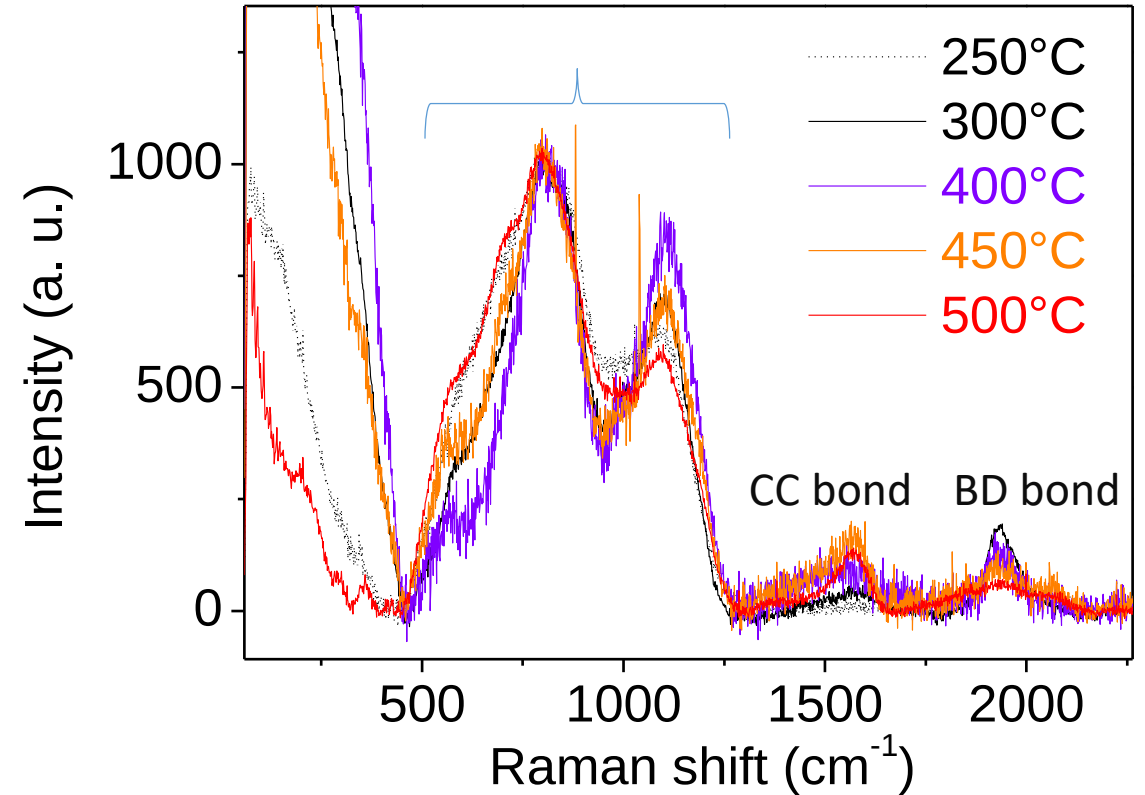
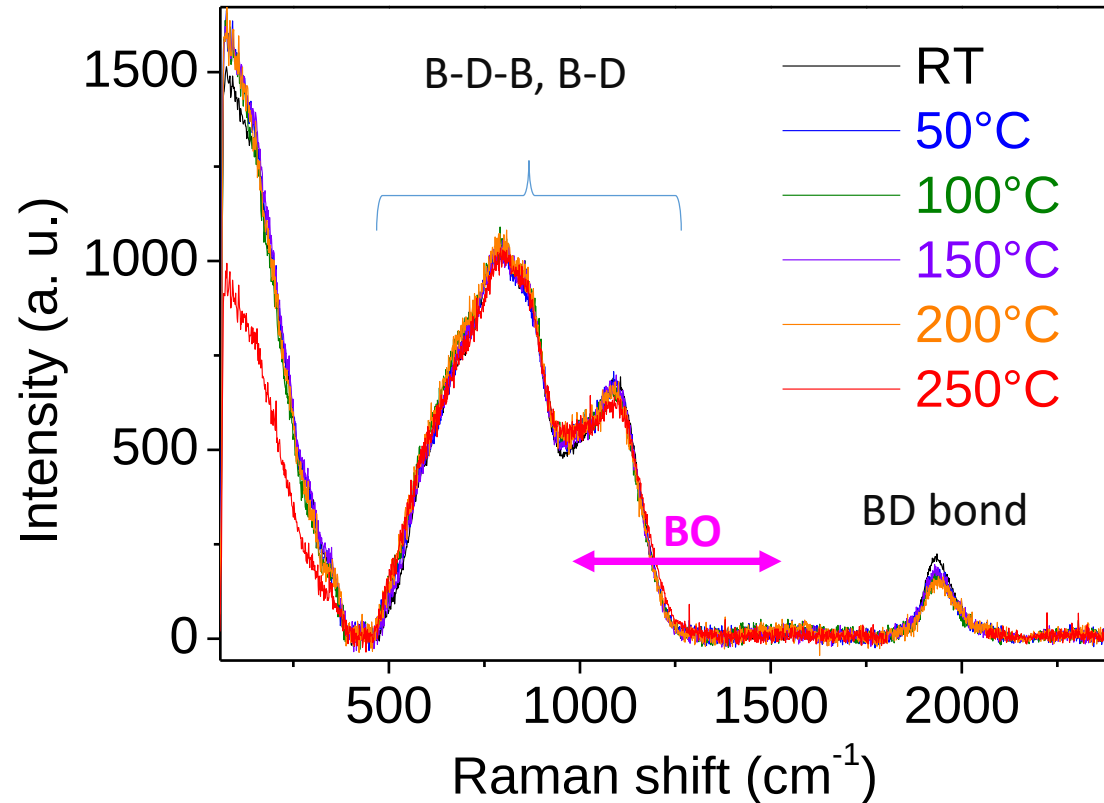


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Appreance of carbon above 250°C: pollution?

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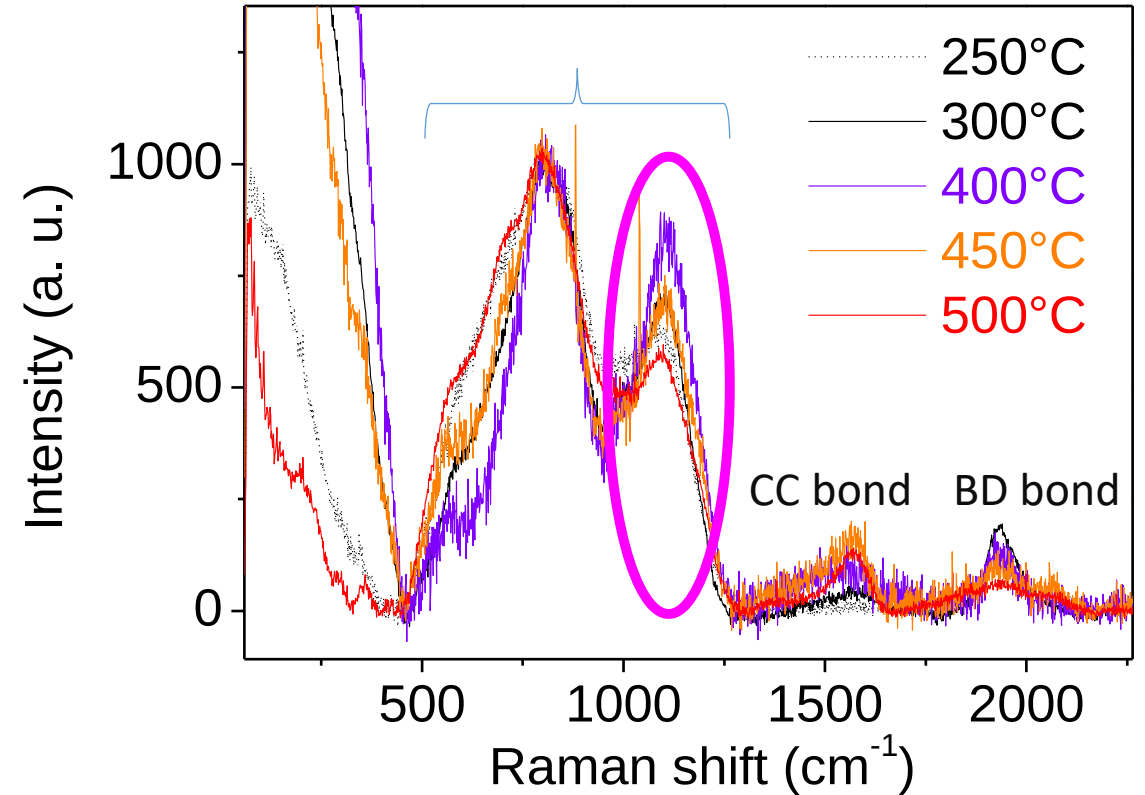
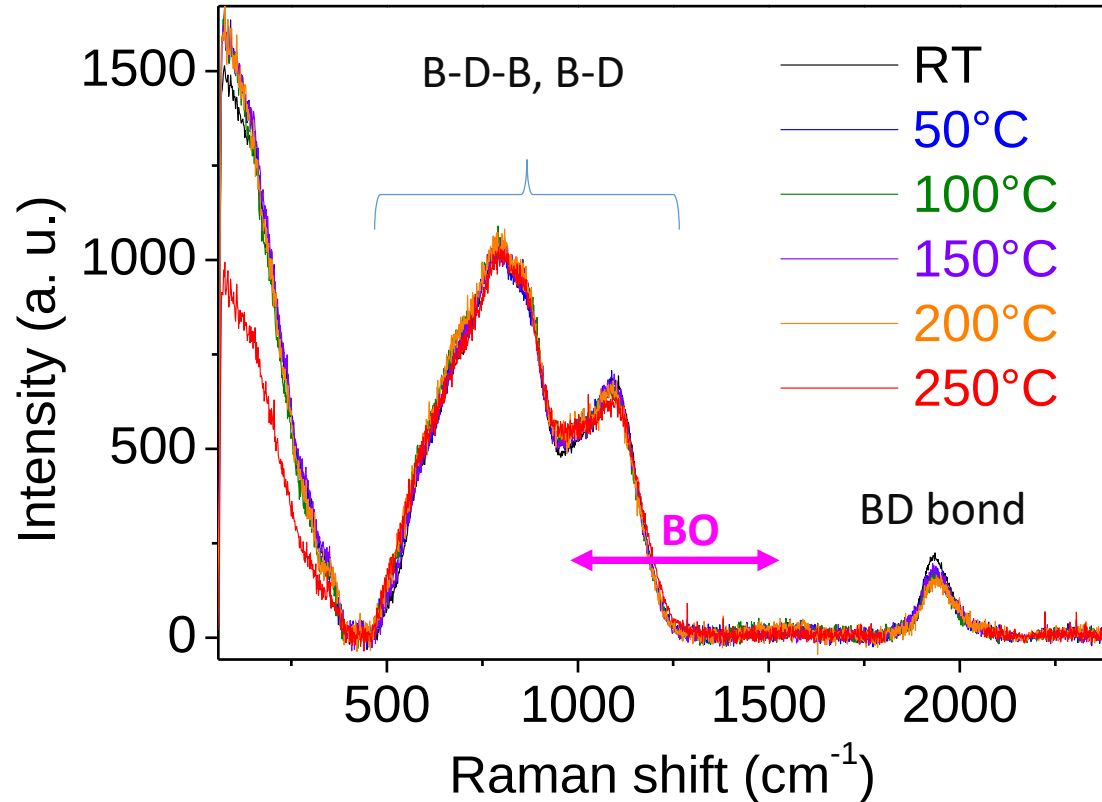
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BD bond intensity diminishes with T but difficult to quantify. Need to couple with other techniques !!!

Raman microscopy (out of white zones)



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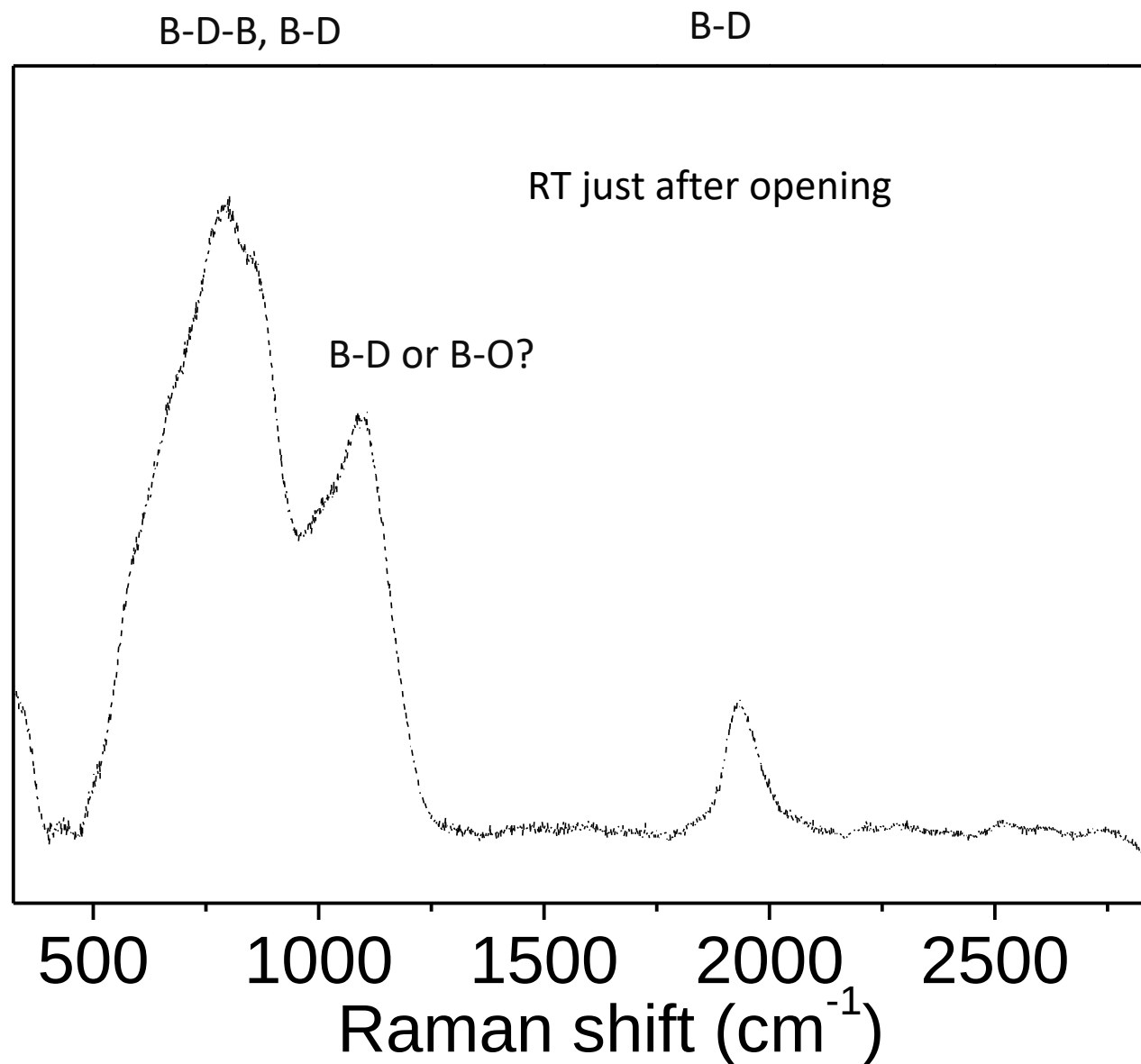
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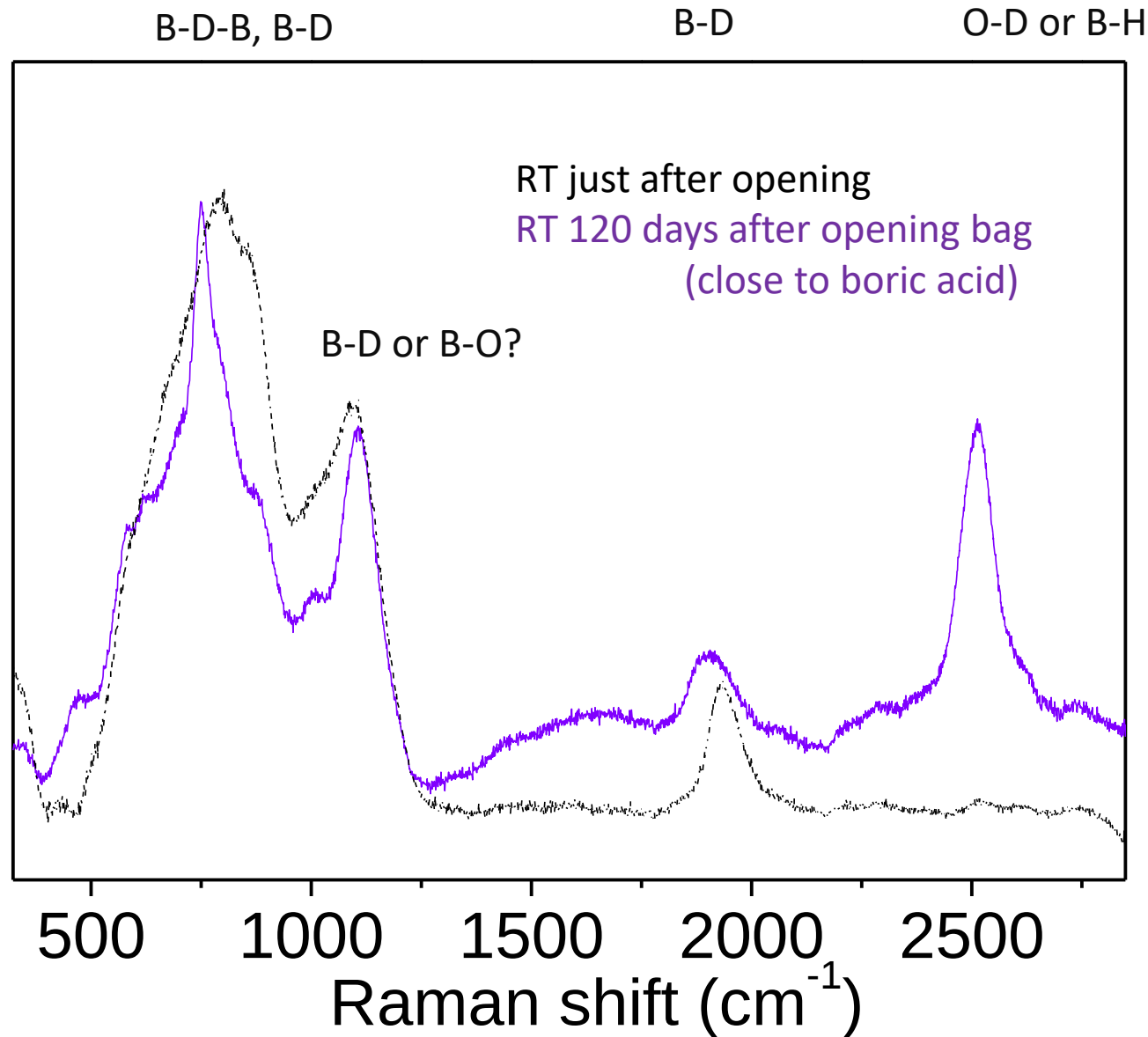
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Band at 1100 cm^{-1} due to BO?

Raman microscopy (out of white zones)



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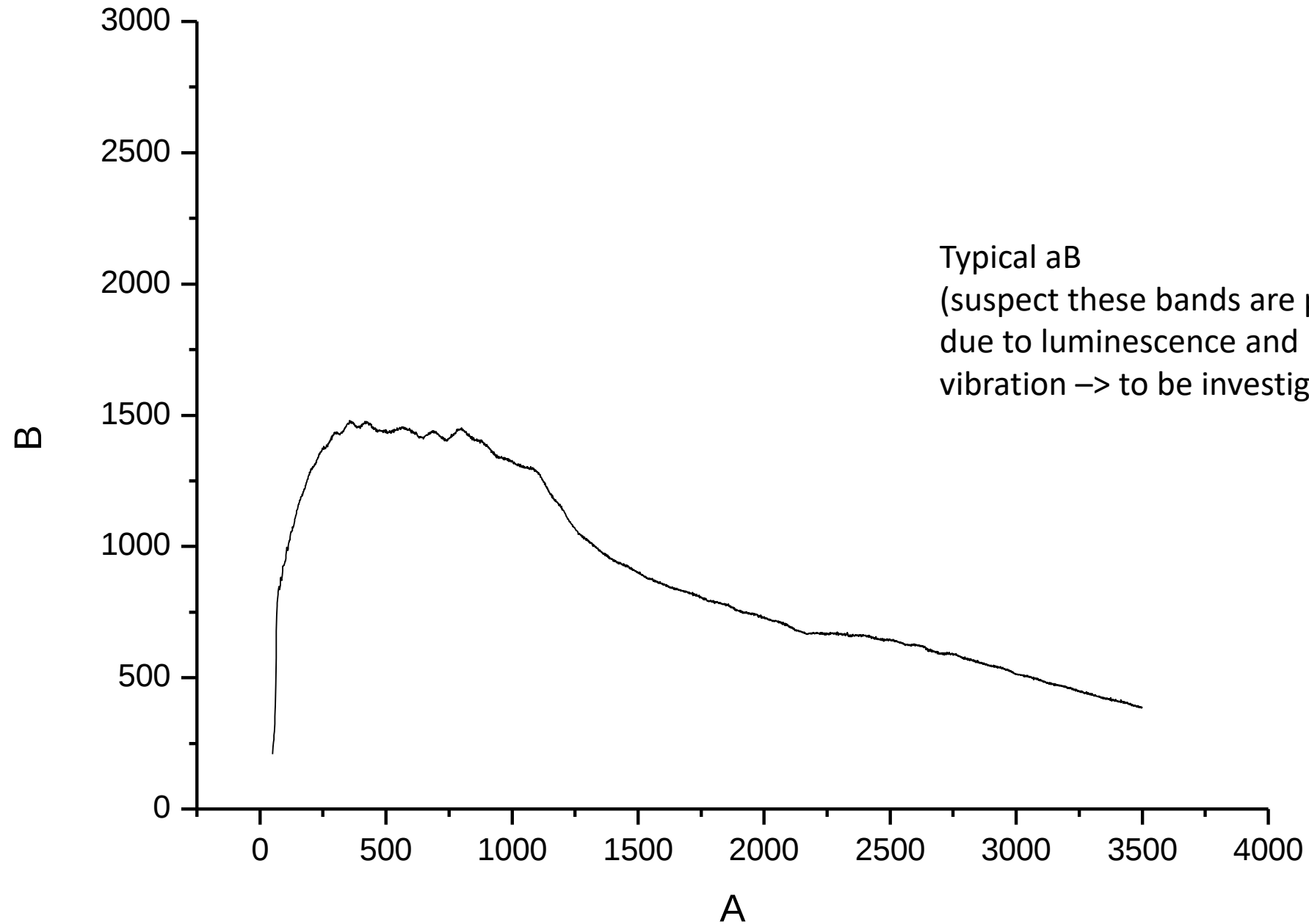


Could be:

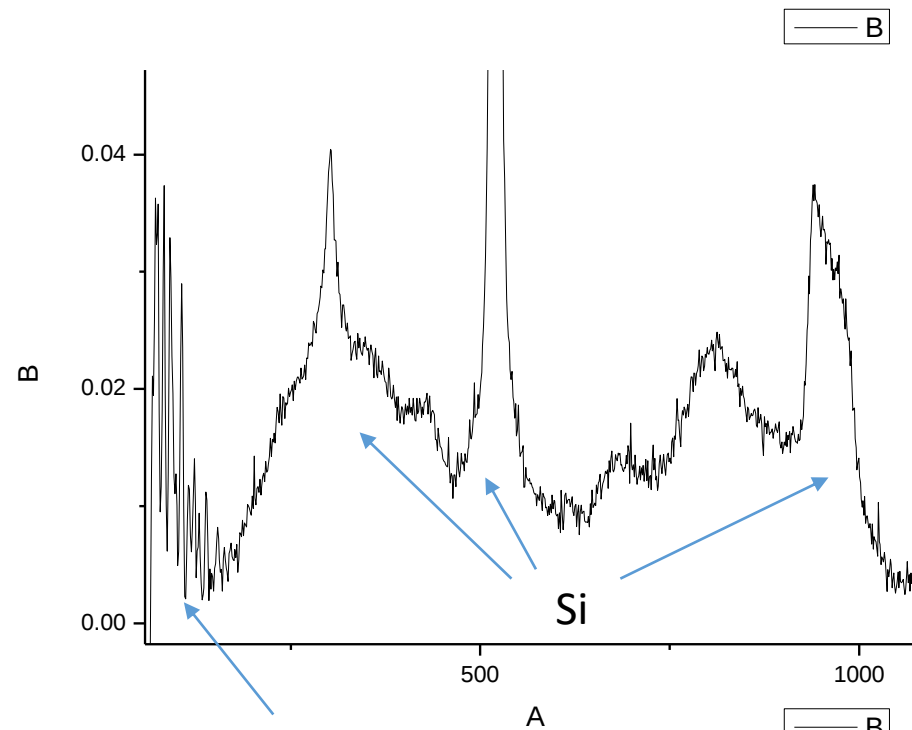
- BO

- BH

(pollution with hydrogen.
Remember we obtained
hydrogenated boric acid)

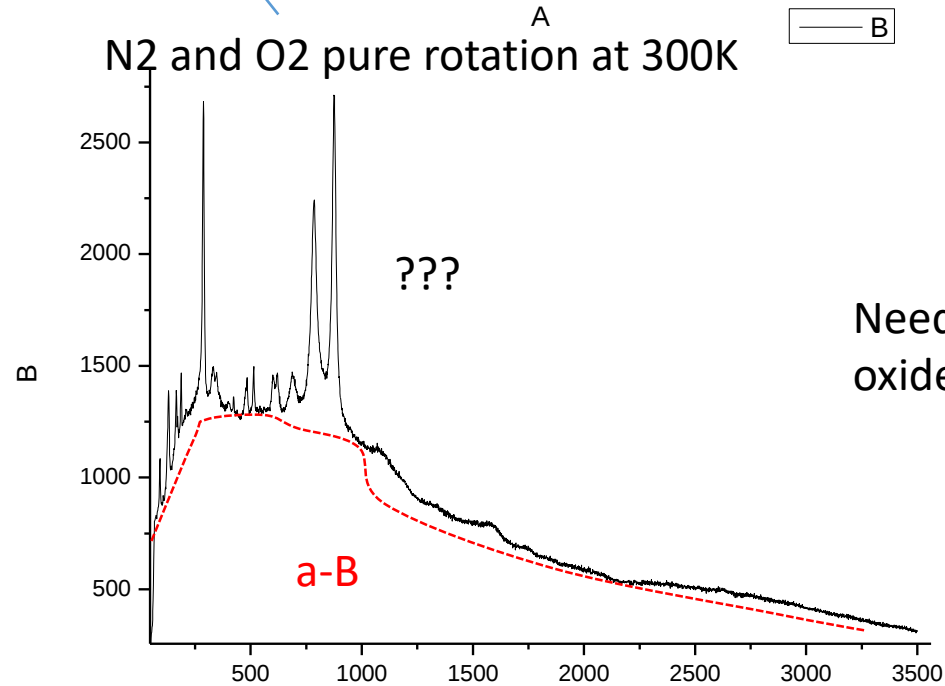


On squarred silicon



Not possible to interpret easily (too thin)

N₂ and O₂ pure rotation at 300K



Need to know more: is it an underlying tungsten oxide? Or something related to boron ? Cristalline?

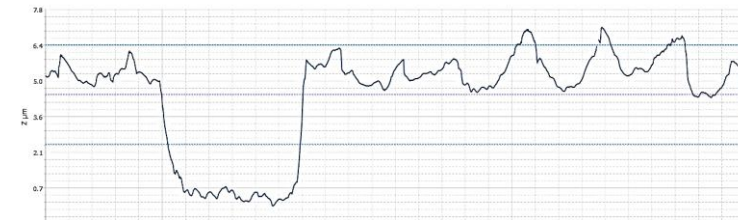
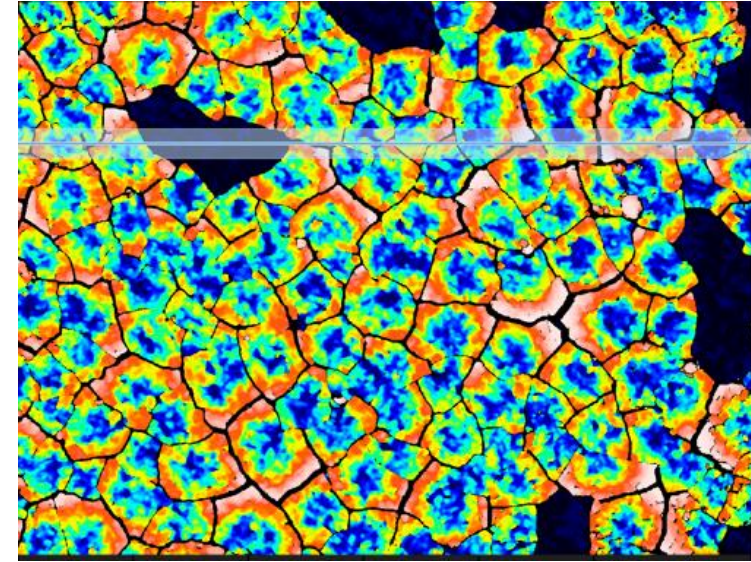
- Story to be continued...
- Comparison with other samples (L. Marot / magnetron sputt)
- Comparison with old samples from Milano
- But of course:
 - need of B-H with RT, 50,...500°C
 - need of B with RT, 50, ... 500°C

Confocal microscopy *(Bag opened: 16th of may, measurement done on 5th of june)*

500°C



≈ 6 micron step

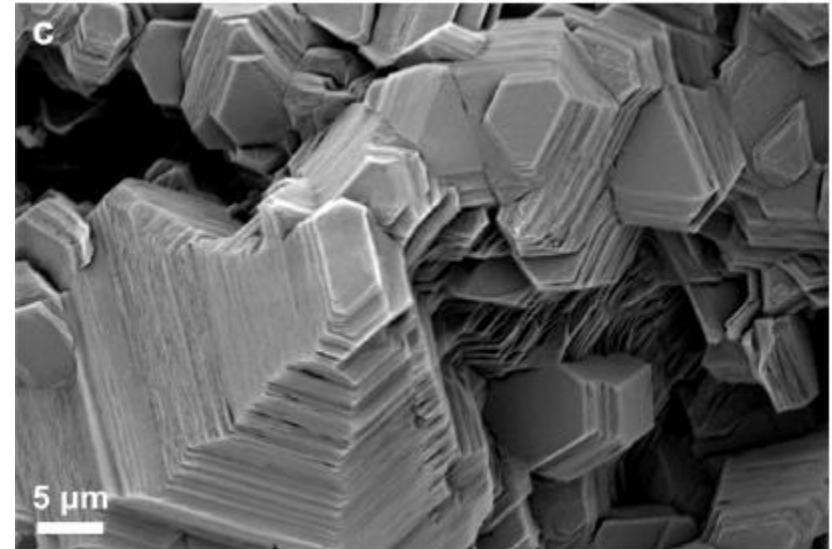
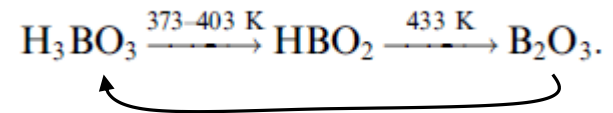


**Presence of huge cracks and partial delamination for T=500°C.
Delamination visible for lower T**

Raman microscopy (on white zones)

Boric Acid: a van der Waals material,
with hydrogen bonds

- 6 eV gap insulator
- *Low thermal stability*



Larsson et al Tribology International 171 (2022)