The use of synchrotron as an alternative IR source in a hit-and-run case

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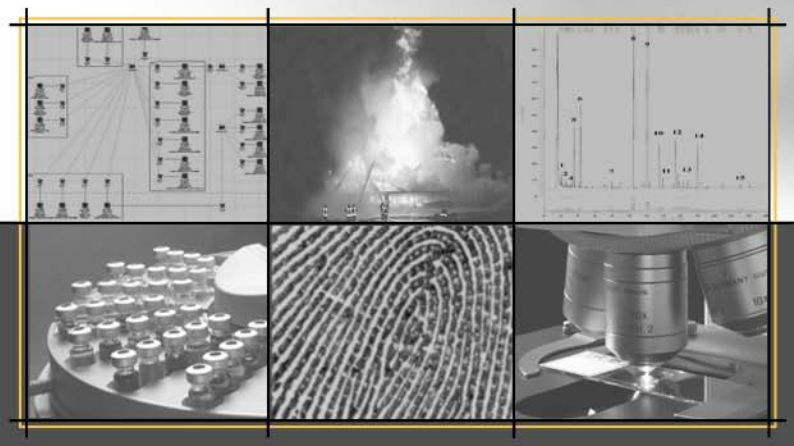


ESC | école des sciences criminelles

UNIL | Université de Lausanne

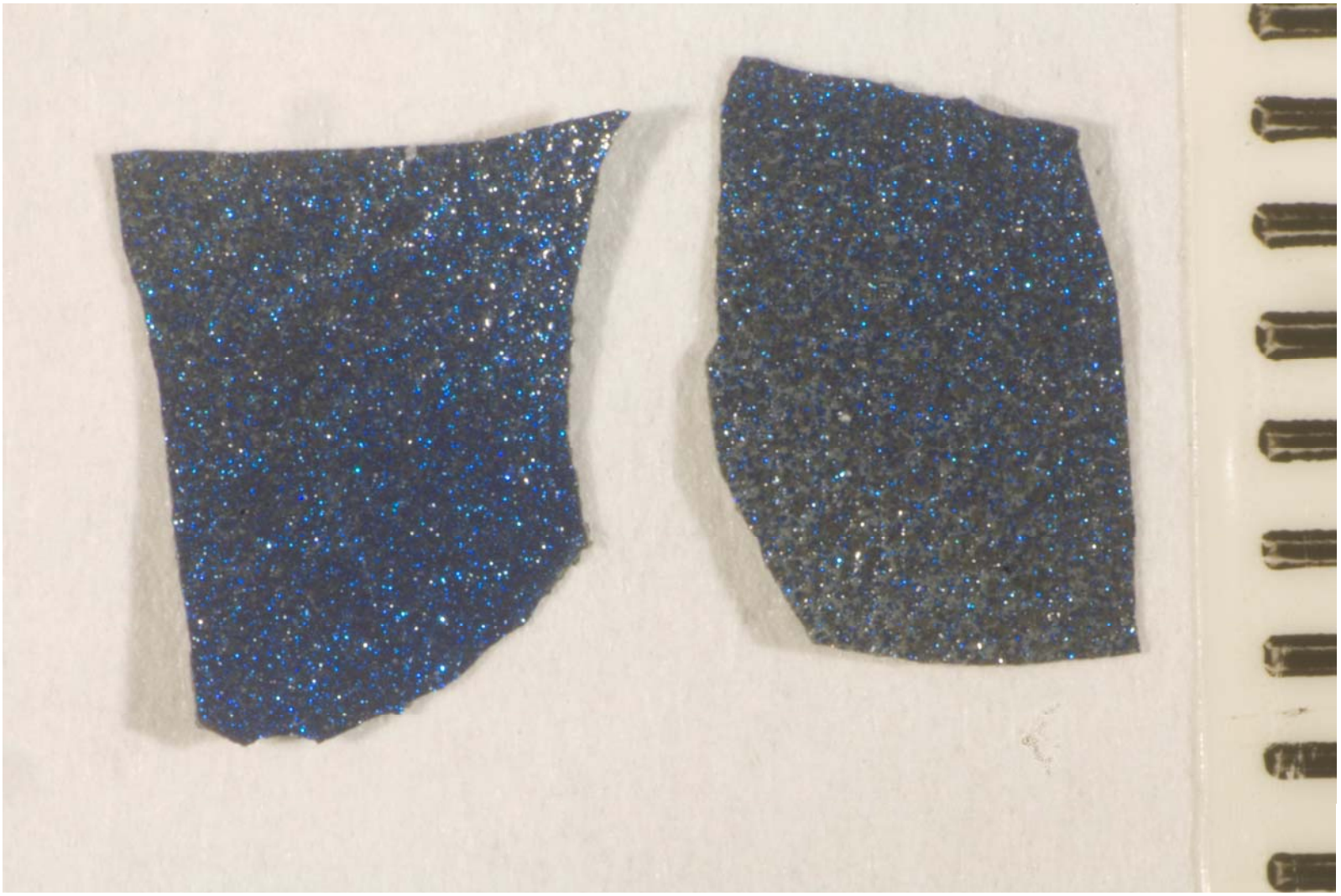
Introduction

- A paint flake (dark blue effect paint) was found in a hit-and-run accident.

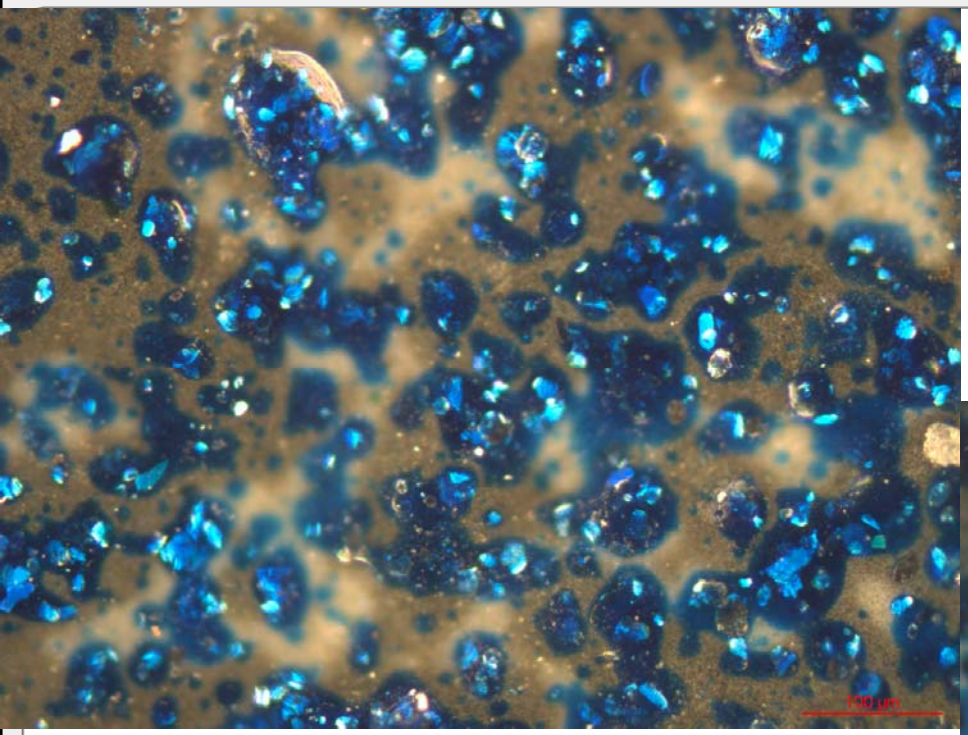
- Mission:

  - To provide all the possible information concerning the source of this fragment.

Paint, surface, general view

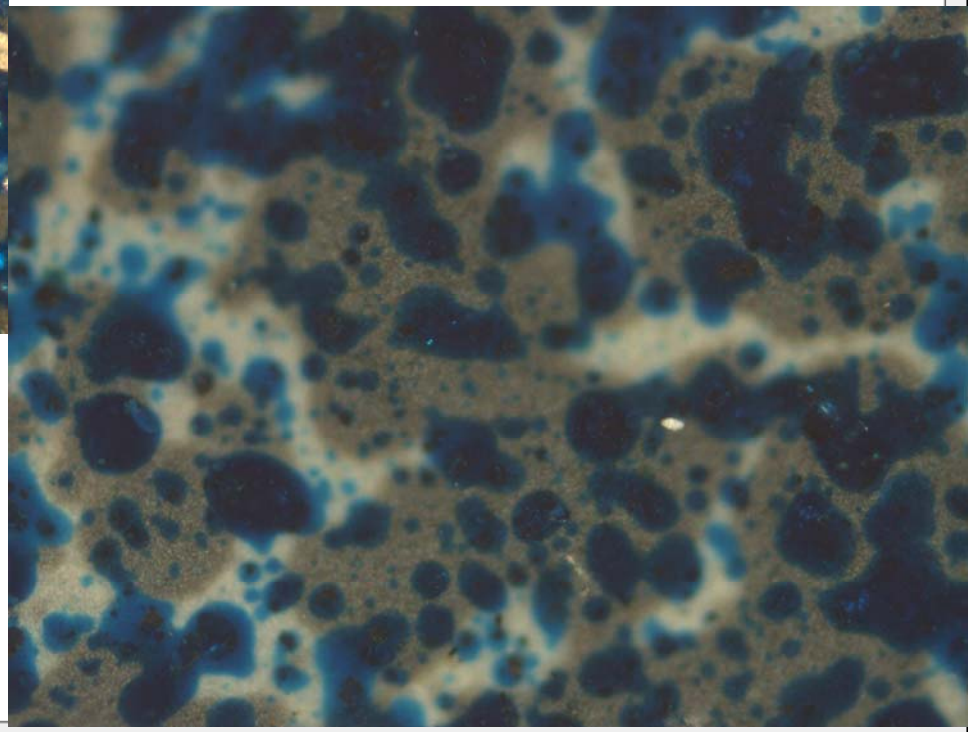


Paint surface, microscopy

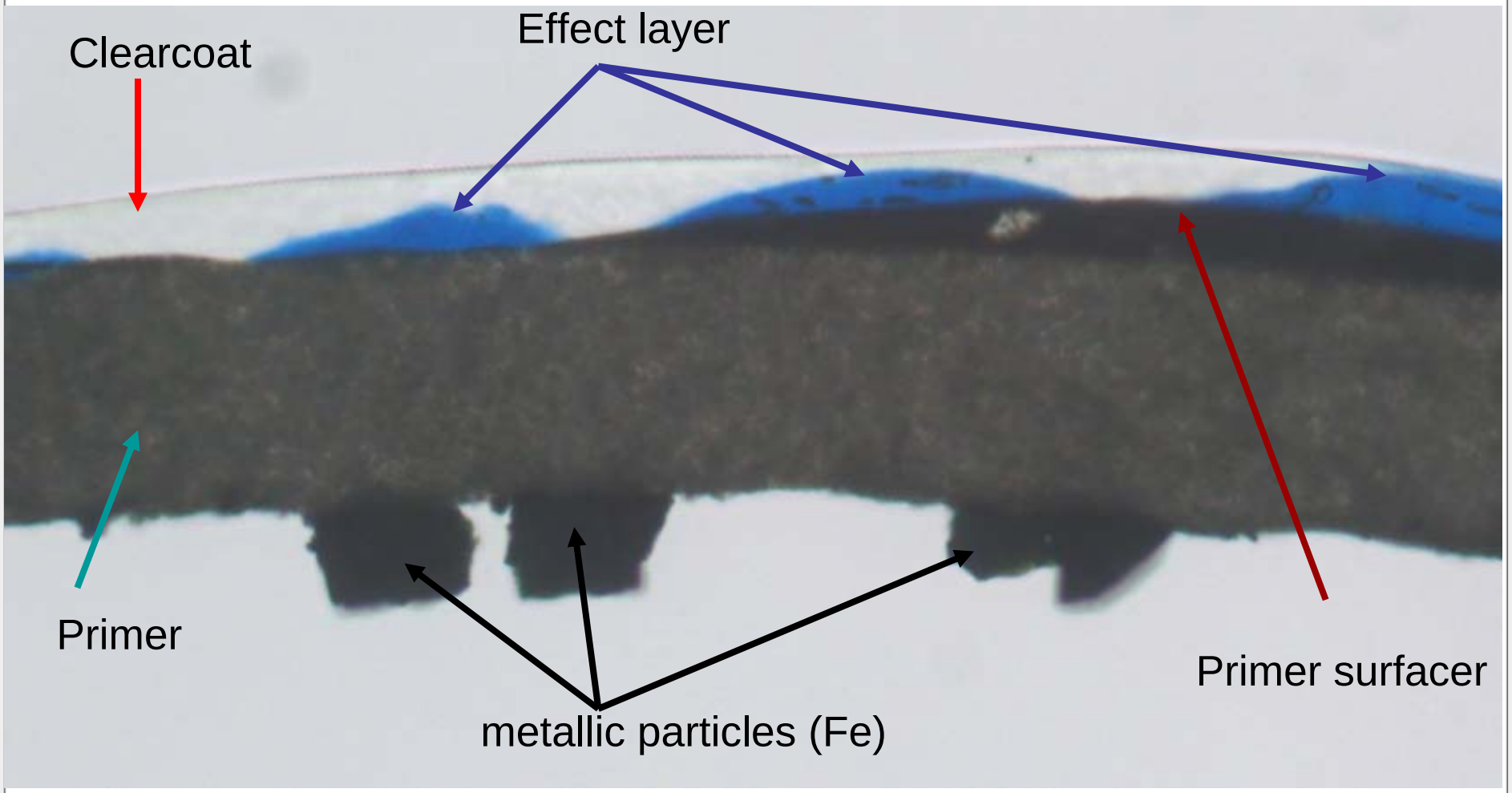


Bright field

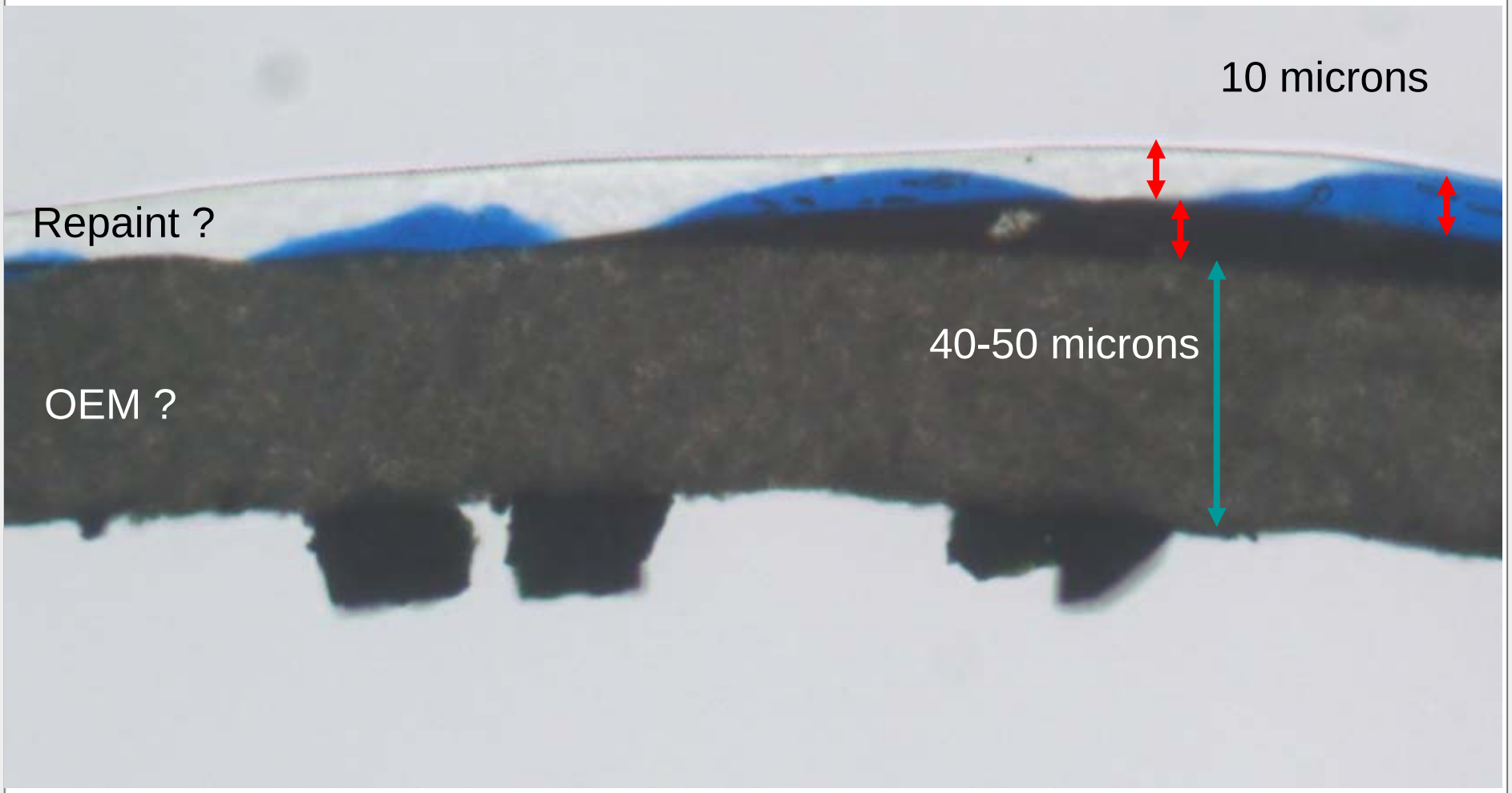
Dark field



Thin section, bright field



Thin section, bright field



FTIR

- Due to their small size and uneven application
  - Clearcoat
  - Effect layer
  - Primer surfacer
- were difficult to measure with a standard IR microscope (32x obj.).
- Main difficulty: avoid the contribution of neighboring layers in the resulting spectrum.
- *However, the chemical composition of each layer indicates an OEM paint system…*

EPG - Help

- The complete system was not found in EUCAP (+ IR spectra not always reliable)
- Color comparison was subject to large error….

1. How can a OEM paint system look like this ?
2. EUCAP help.

- Special thanks to:
  - Wolfgang Langer (BKA)
  - Jean-Charles Bouat (IRCGN)

EPG - Help

1. - Problem in the production chain.
   - Indication of a paint from the **internal part** of the vehicle (boot, internal part of the doors…) where the quality of the paint is less important.

2. - Final rather open conclusion indicating the best IR match (make) but explaining the difficulty of this specific sample.

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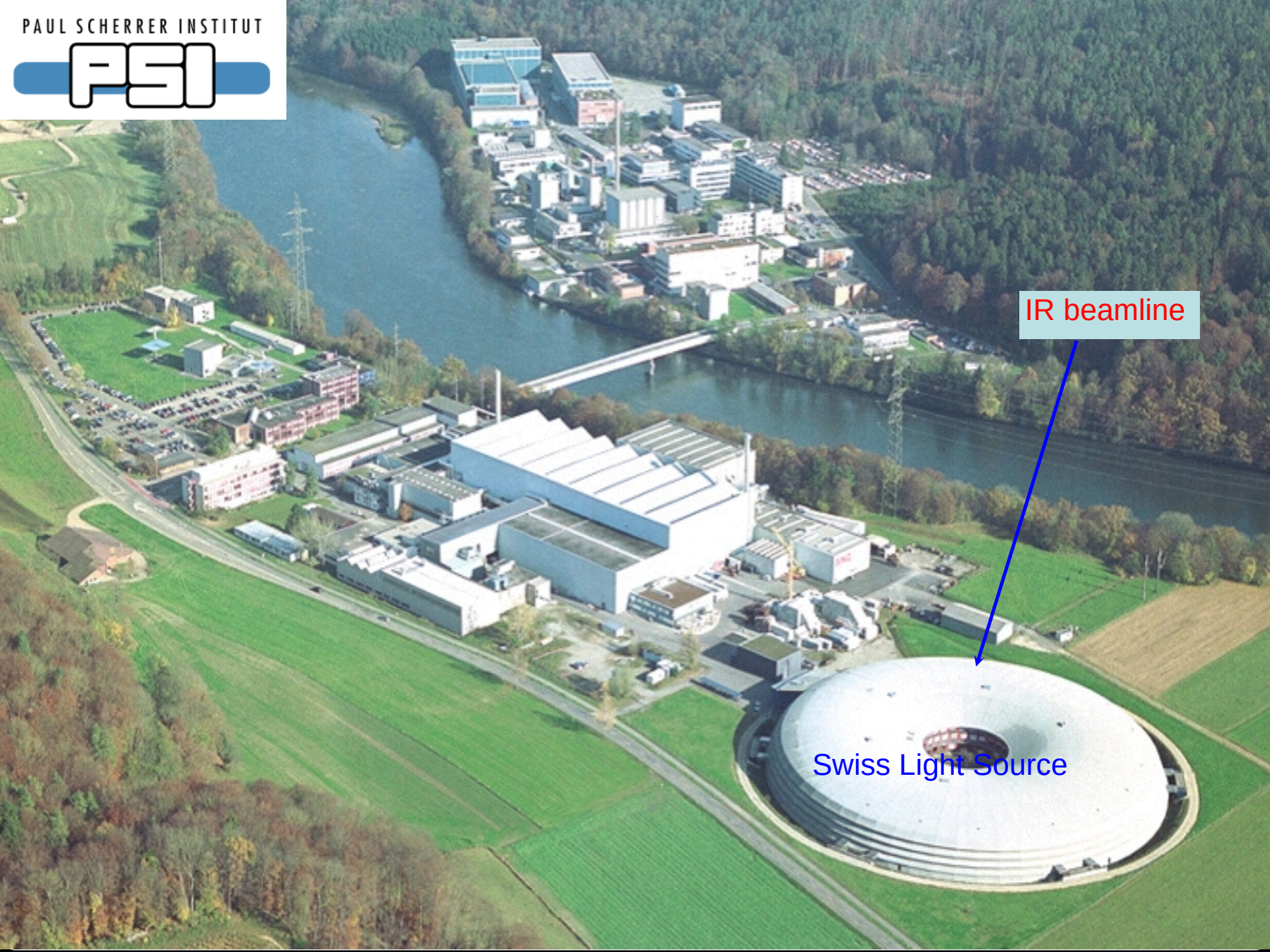
- Previous contact with Dr Philippe Lerch, PSI.
- Possibility to analyze very small sample size (diffraction limit) using a very strong IR source – synchrotron – instead of the standard Globar.

SYNCHROTRON

- "A Synchrotron accelerates charged particles, such as electrons into an orbit at almost the speed of light. When electrons are deflected through magnetic fields they create extremely bright light, million times brighter than sunlight. Since the fast-moving electrons emit a continuous spectrum of light, with various wavelengths and strength, scientists can pick whatever wavelength they need"

http://www.odec.ca/projects/2005/shar5a0/public_html/how_does_a_synchrotron_work.htm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IR beamline
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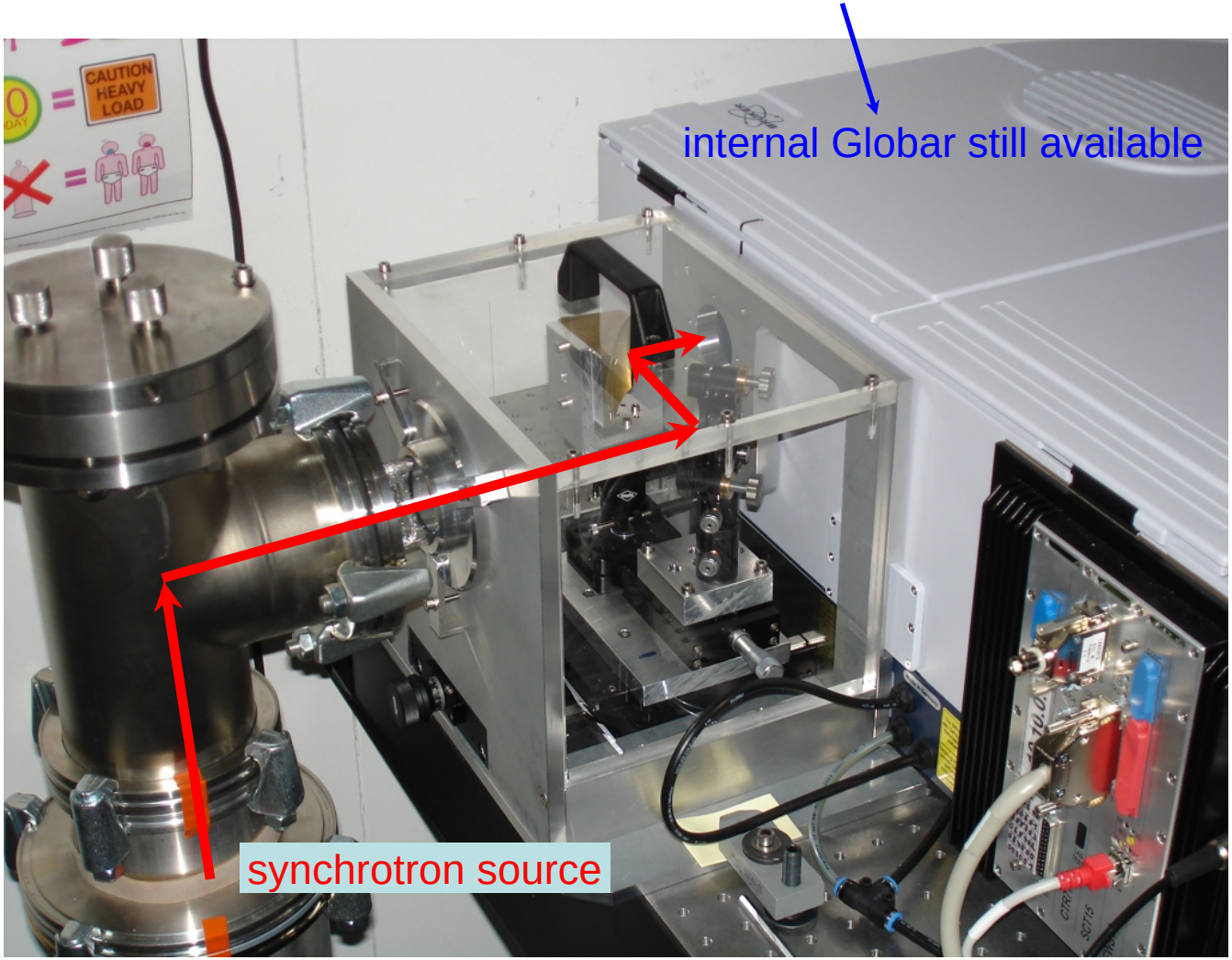
FTIR spectrometer & synchrotron

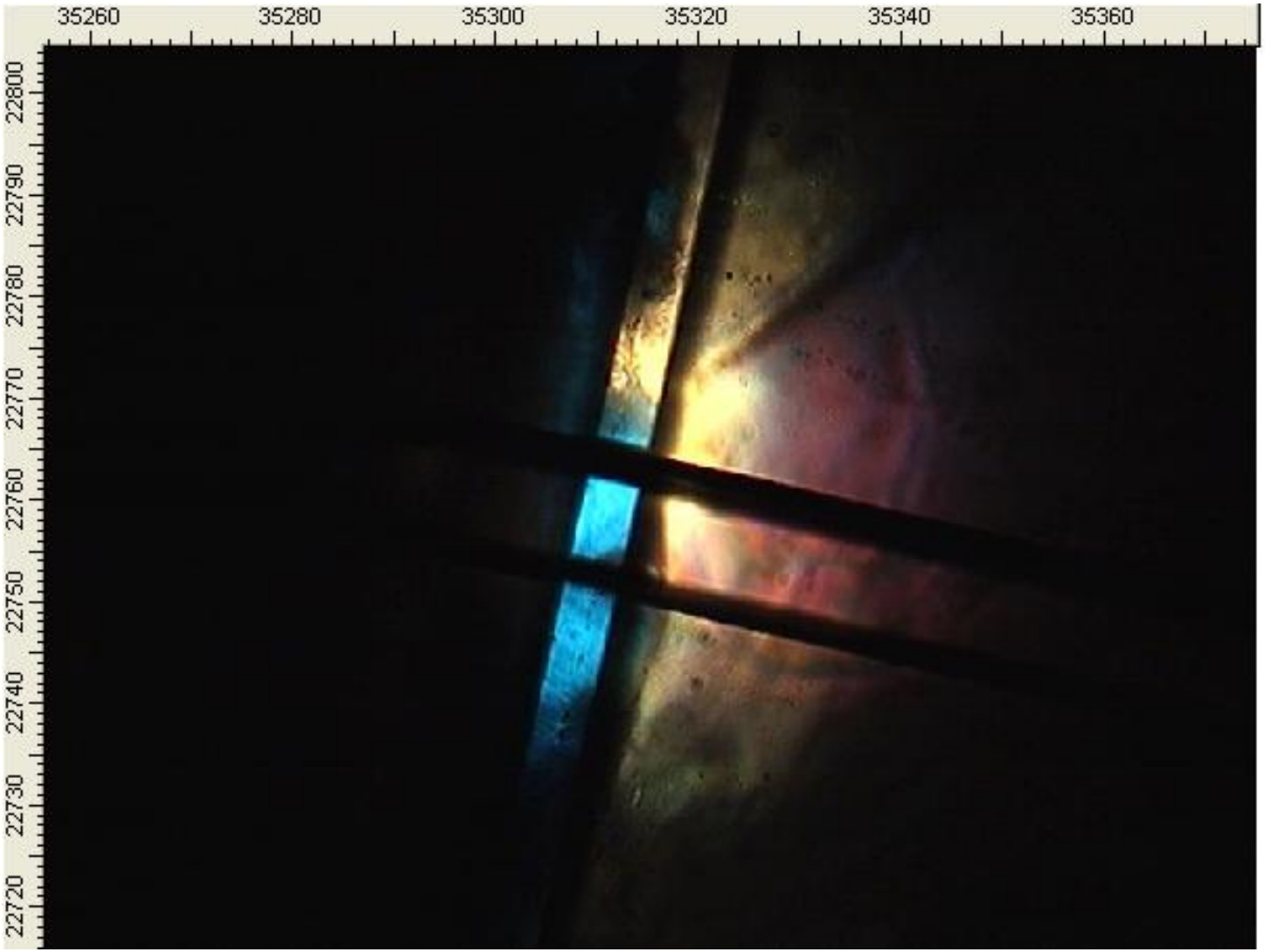
- Standard FTIR spectrometer with a IR microscope.
- High magnification objective (36x) and good quality optics.

Bruker spectrometer, Hyperion microscope

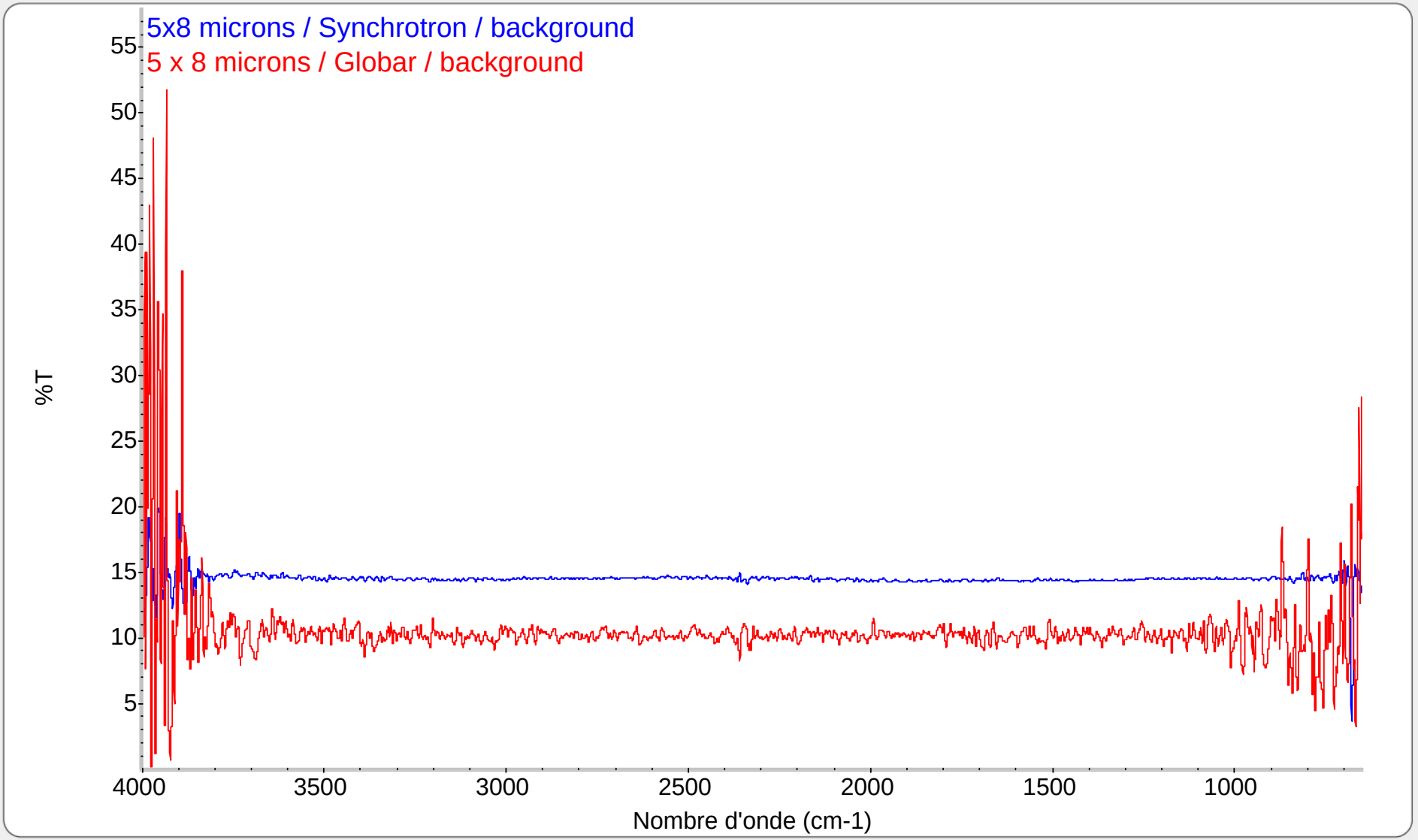
FTIR spectrometer & synchrotron



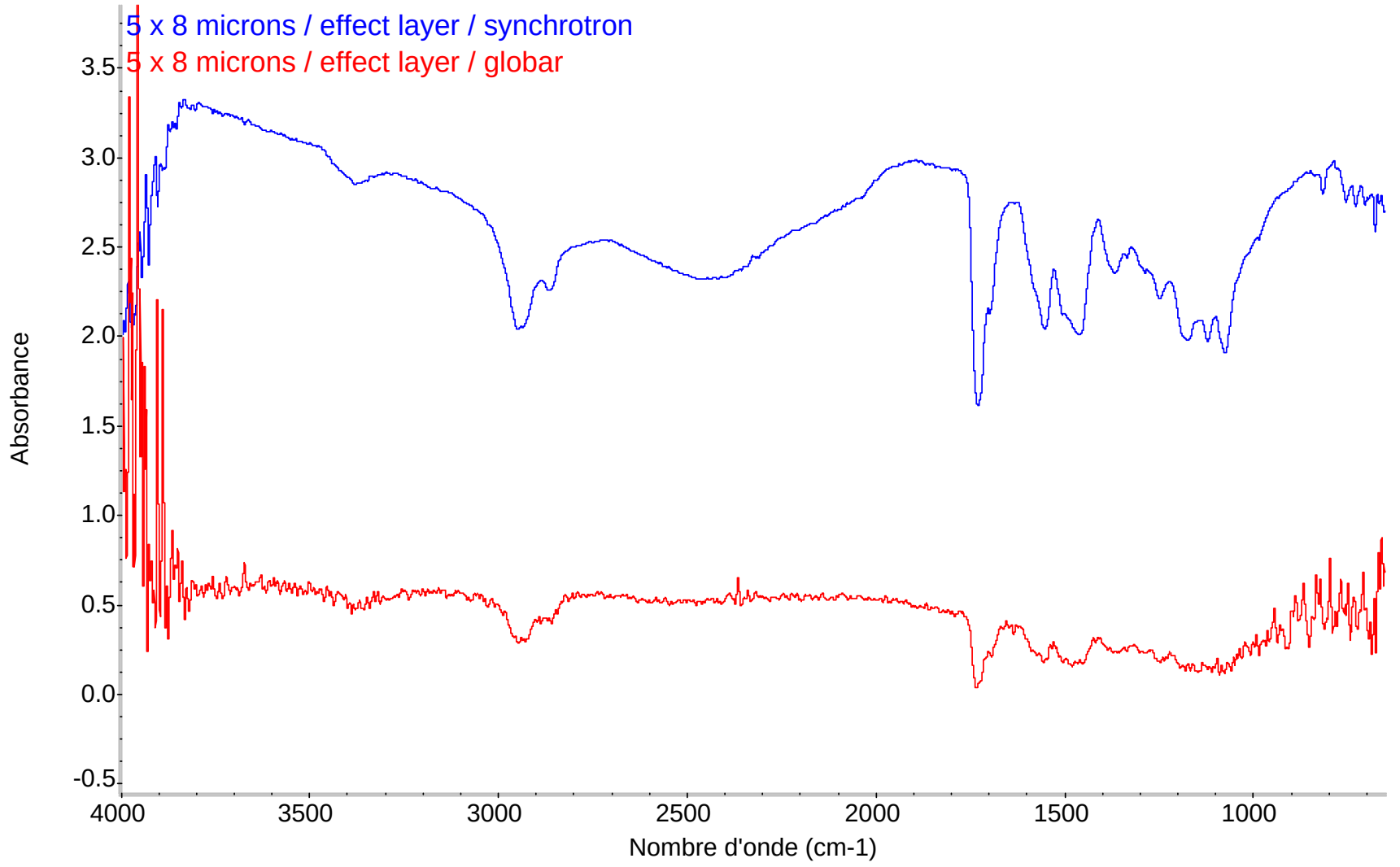
Effect layer, spot size 5 x 8 µm



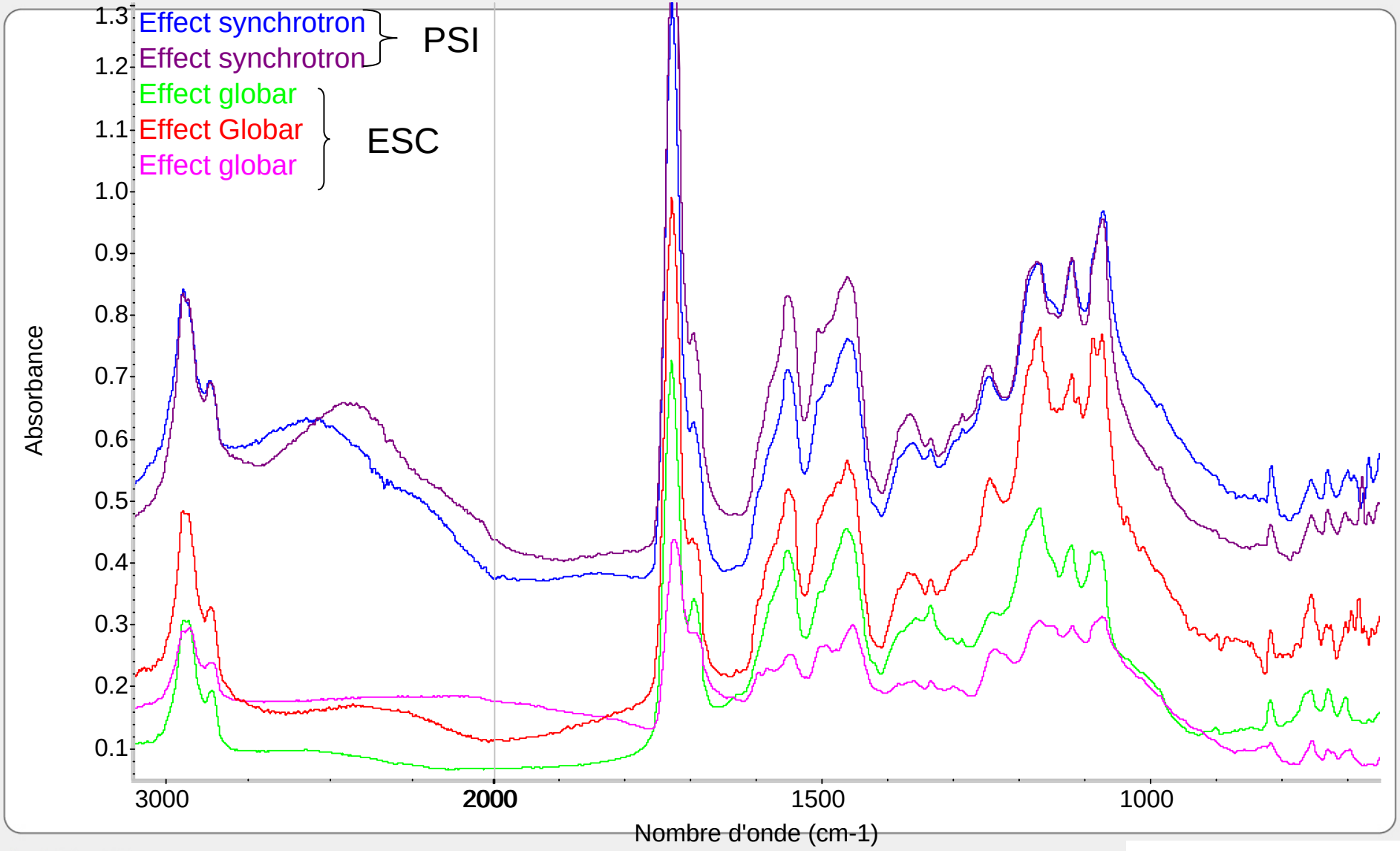
Blank, spot size 5 x 8 μm



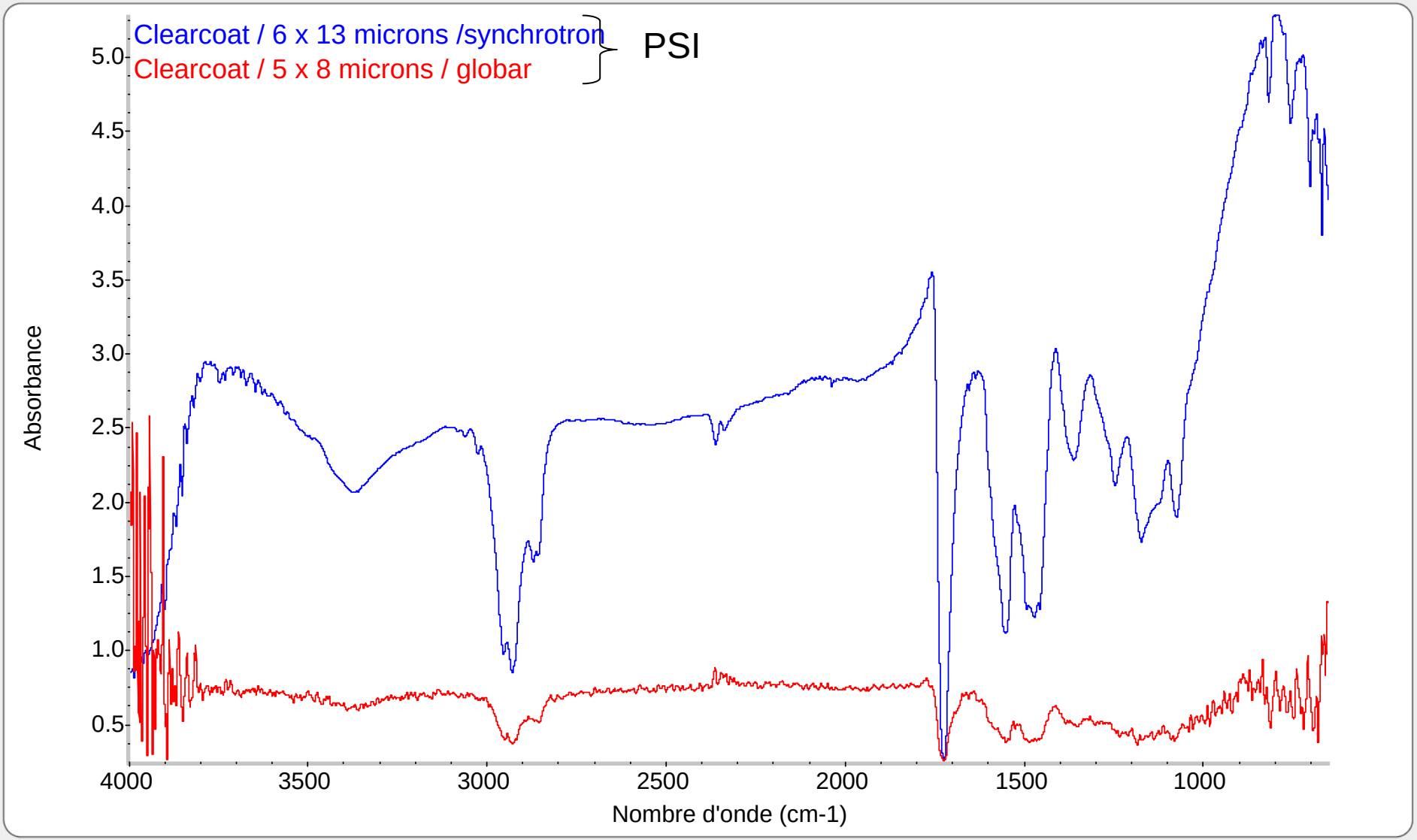
Effect layer, spot size 5 x 8 µm



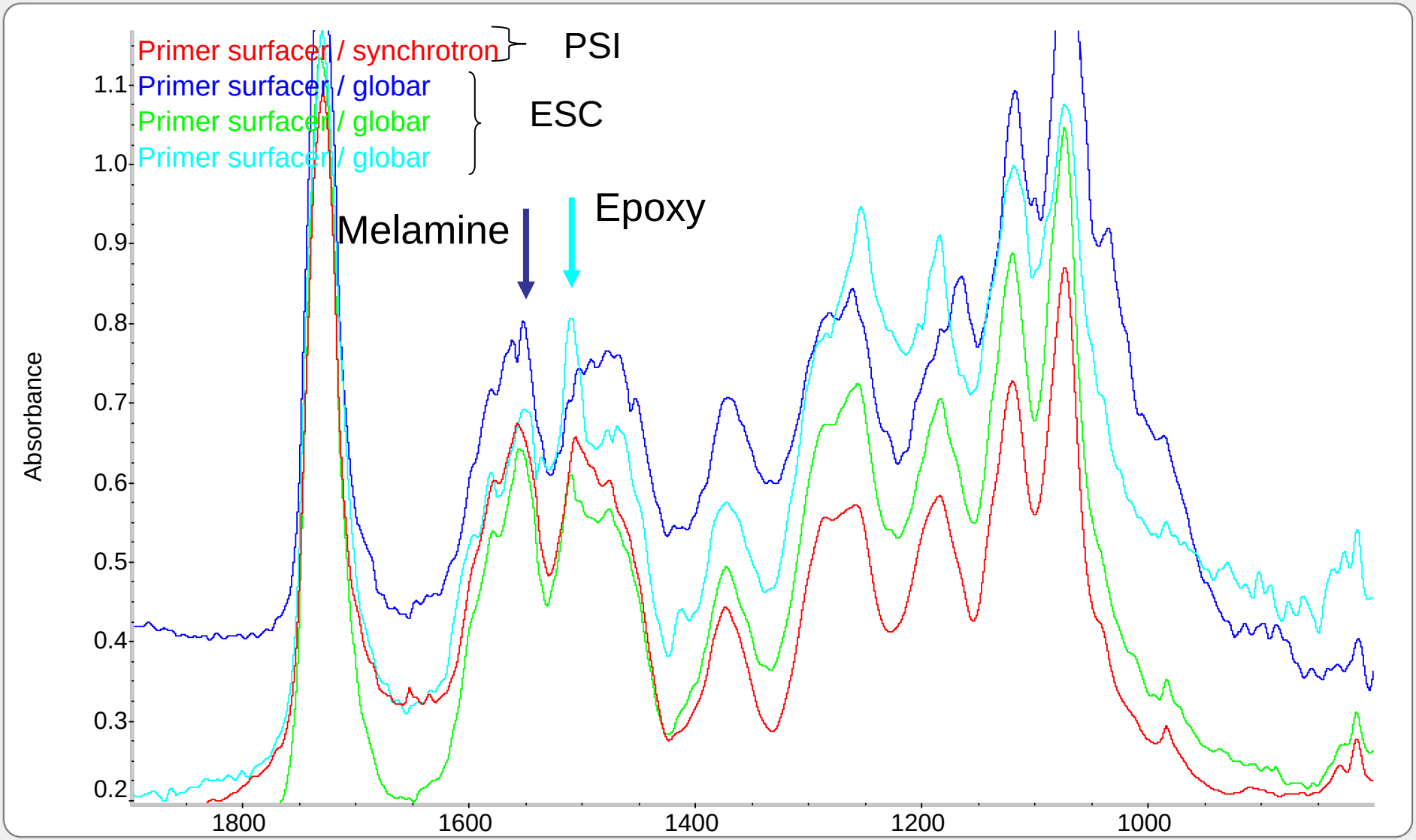
Effect / reproducibility



Clearcoat


Clearcoat / 6 x 13 microns /synchrotron
Clearcoat / 5 x 8 microns / globar
PSI
Absorbance
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
4000
3500
3000
2500
2000
1500
1000
Nombre d'onde (cm-1)

Primer surfacer



Discussion

- The use of synchrotron light source permit to reduce the area measured with an excellent S/N ratio (in our case, 5 x 8 μm) and no interference of the surrounding layers.

- Standard Globar does not allow to measure such small sample size.

Conclusion

- **Synchrotron is the only alternative to measure very small particles or paint layers (less then 10 microns). It is a great help for the forensic scientist in such difficult case.**

- Remark: The optics of the IR microscope is the only limitation factor.

Final remarks to the case

The scenario :

> A black Dodge Caliber parked on a street presents damages on the passenger's door.

> The police found a blue effect paint flake on the street close to the damage area. This paint was transmitted to the laboratory.

> Remark ? Question ?

Laboratory need, remark:

- Comparison paint from the Dodge sampled at the damaged area.

- The link between the paint flake found on the street and the vehicle that caused the damage on the Dodge cannot be established by laboratory means.

> After the sending of the report (with these two limitations clearly mentioned) the VIN number of the car was finally checked and …

> The damaged **black** Dodge Caliber is in fact **blue metallic** !!!!!!!!

Lessons to learn

- Good contact with the investigator (not always the person asking for the analysis).
- In all cases, clearly state the limitations of your investigation in the context of the case (if possible with a written acceptance of the client).

Thank you all for your attention

Any questions ?