



Identification and classification of textile fibres using ATR-FT-IR spectroscopy with chemometric methods

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About us

- University of Tartu
Chair of Analytical Chemistry
- Other studies in our research group
 - Painting materials
 - Paper
 - Varnishes
 - Dyes
 - ...
- PhD student :

Development of set of methodologies on the basis of instrumental techniques for analysing textiles, dyes and related materials



Importance of textile analysis



- Conservation
- Archaeology
- Authenticity control
- Forensic science

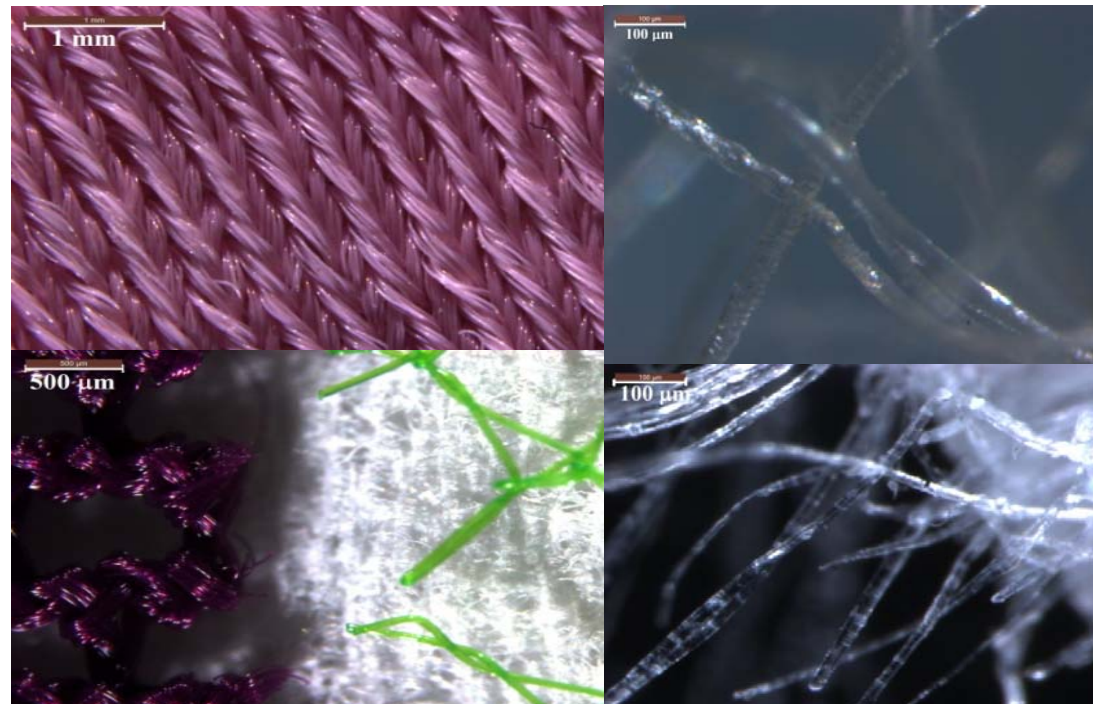


Carpet from the Estonian National Museum

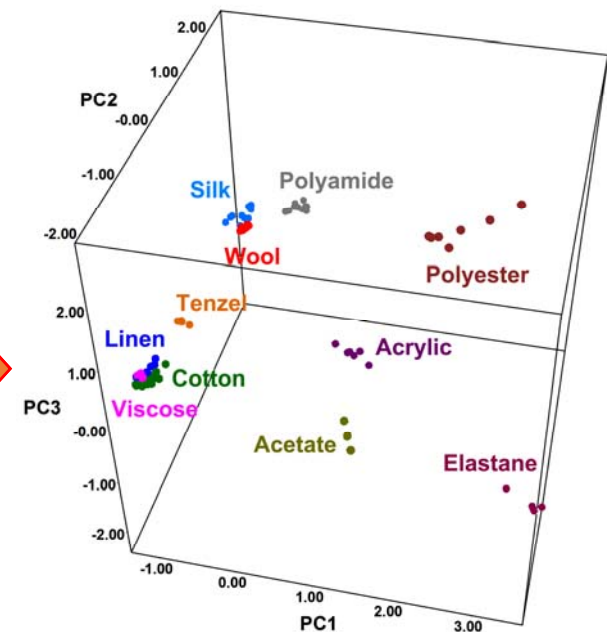
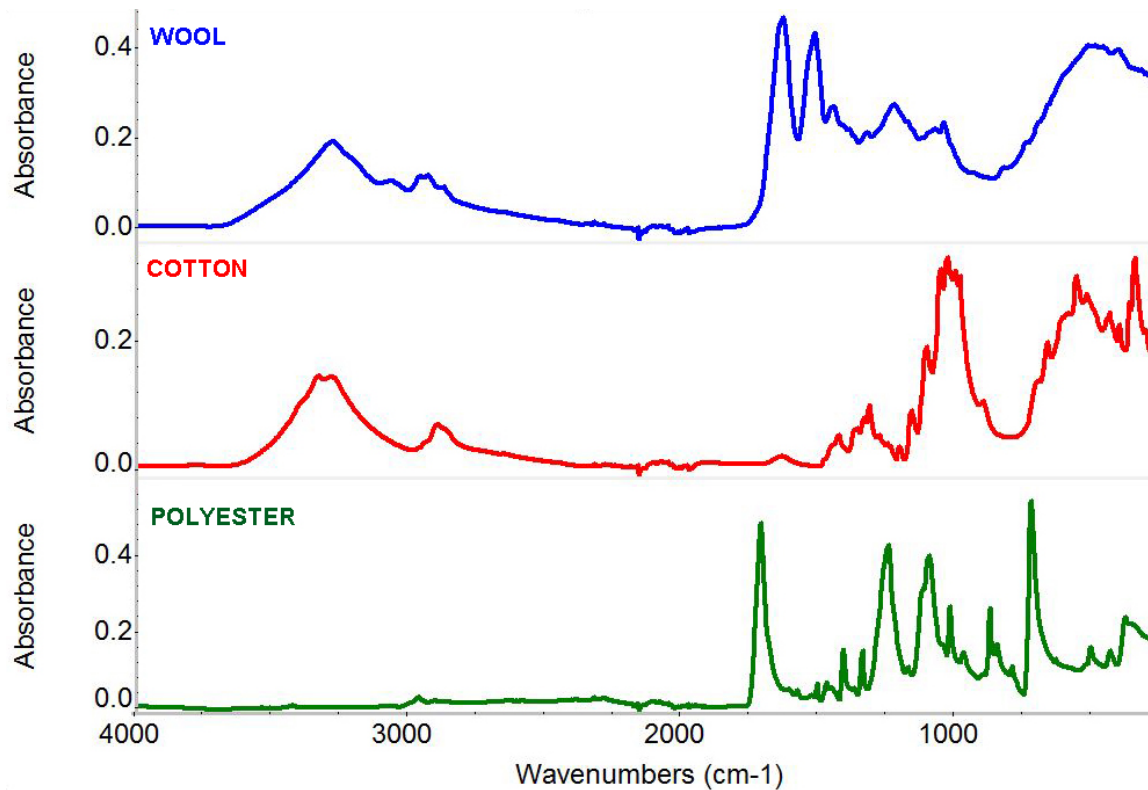
Analysis methods for textile fibres



- Microscopic analysis
- Burning test
- Solubility test
- Pyrolysis gas-chromatography
- **ATR-FT-IR**



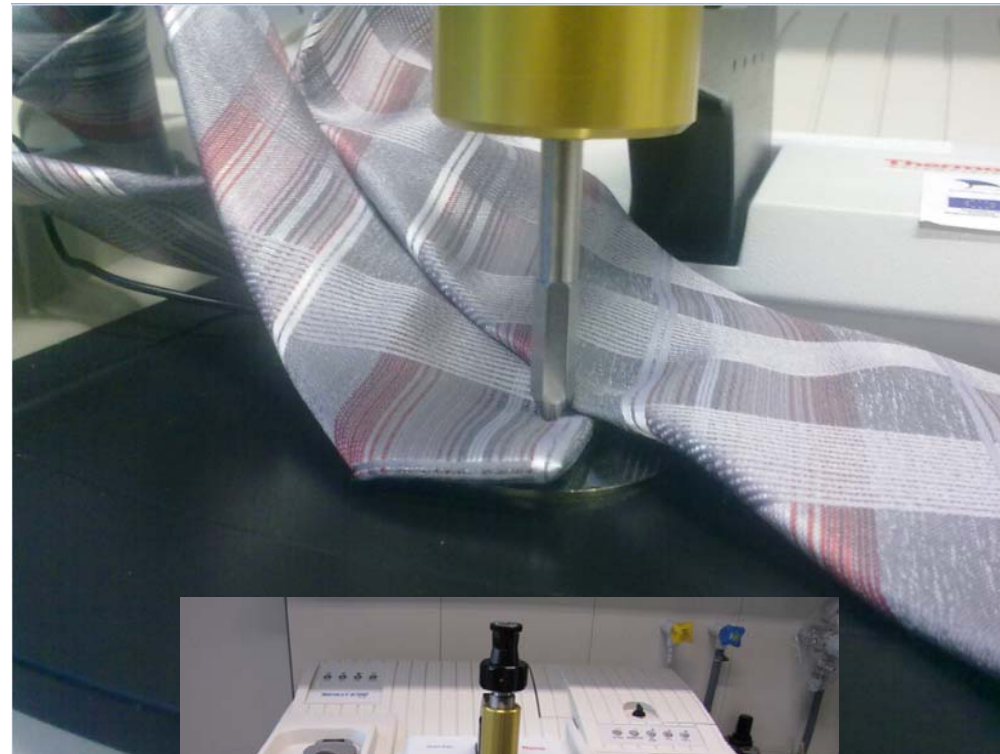
Aims of the Research



Attenuated Total Reflectance Fourier Transform InfraRed spectroscopy



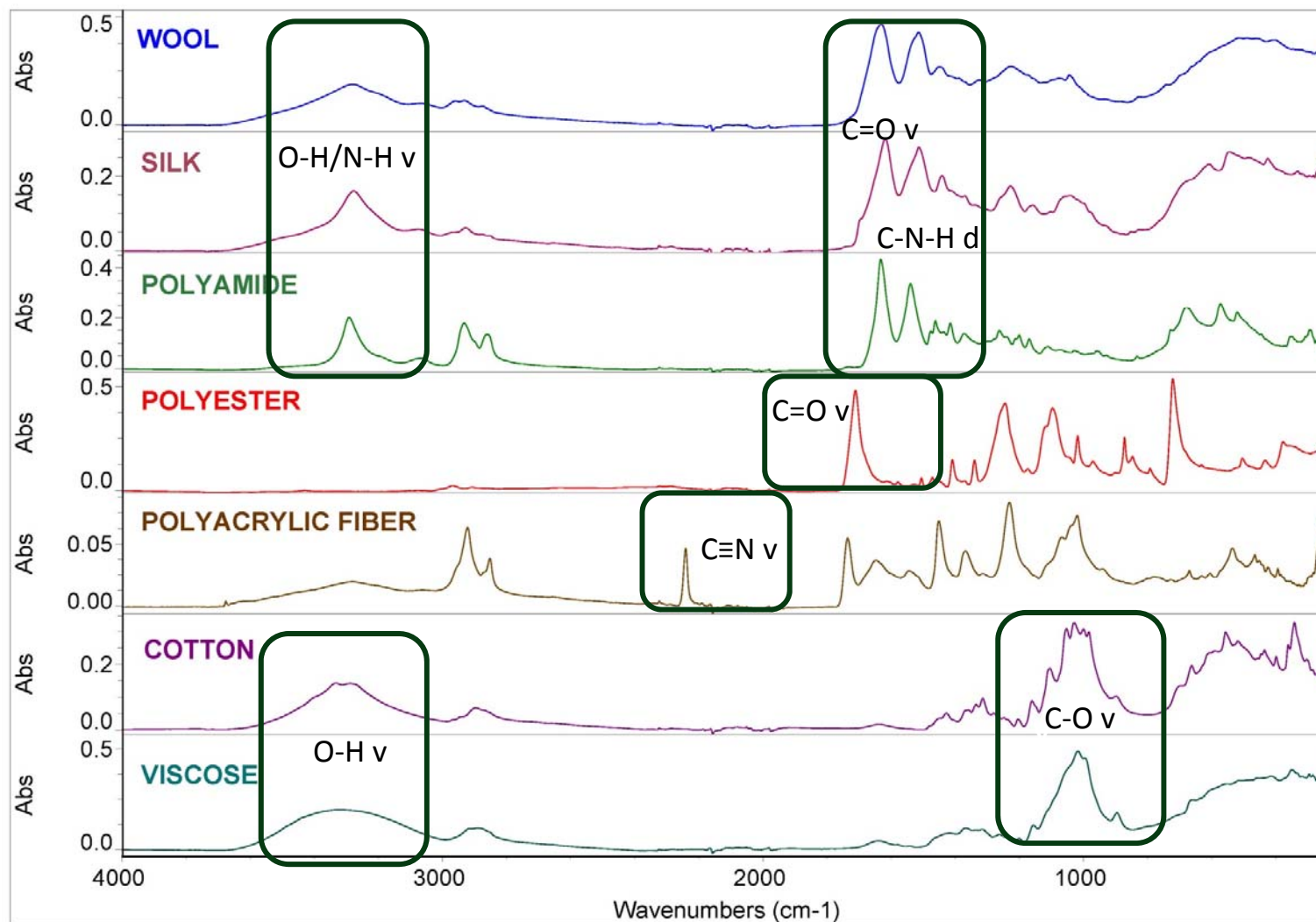
- Easy
- Quick
- Non-destructive
- Qualitative and (semi-)quantitative analysis



ATR-FT-IR spectra of fibres

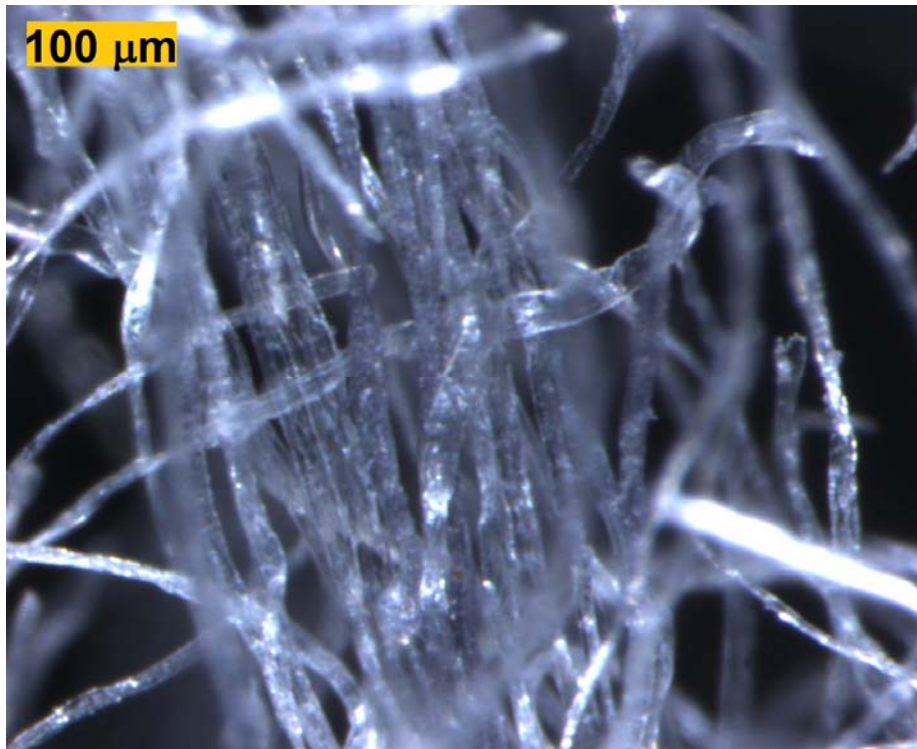


Vahur, S. et al. *Anal. Bioanal. Chem.* **2016**, 408, 3373–3379.

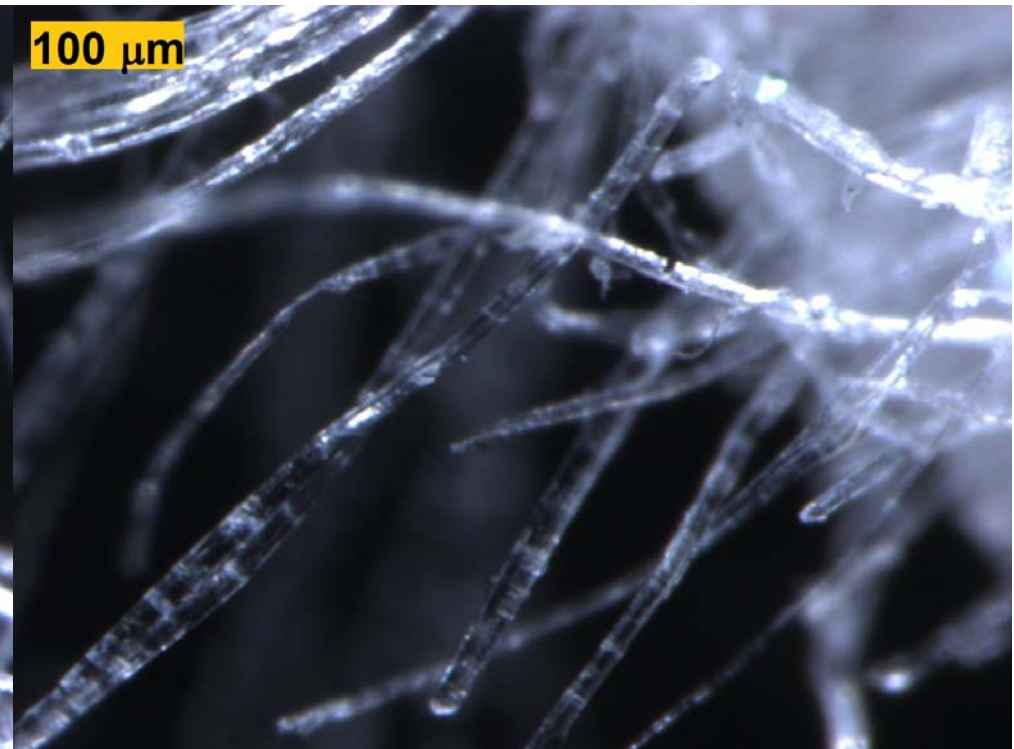


http://tera.chem.ut.ee/IR_spectra

Microscopic analysis

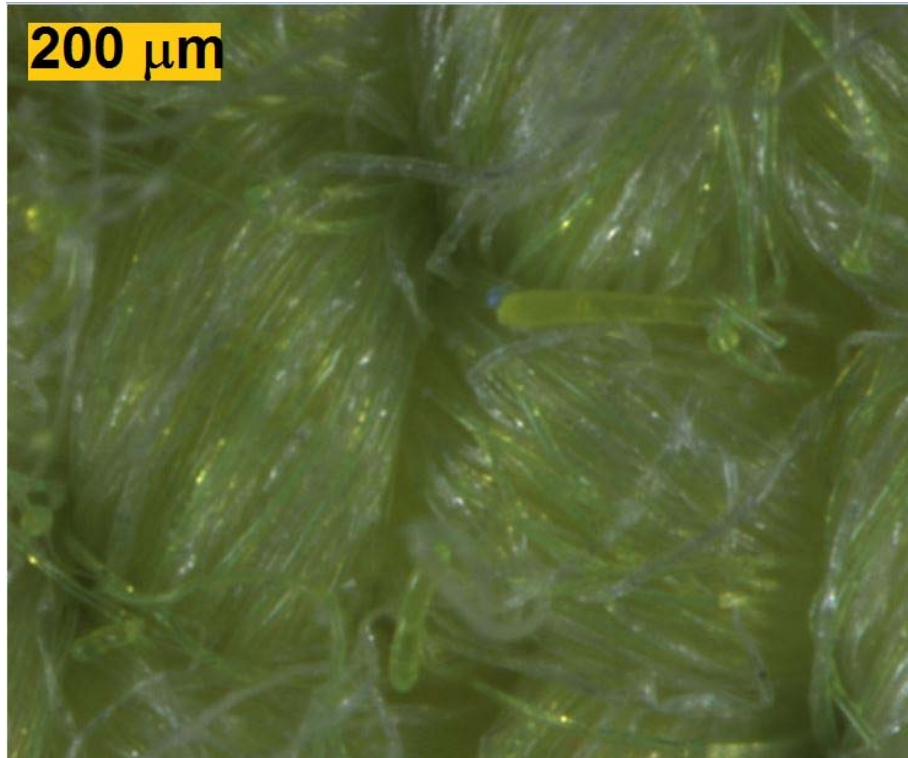


Cotton

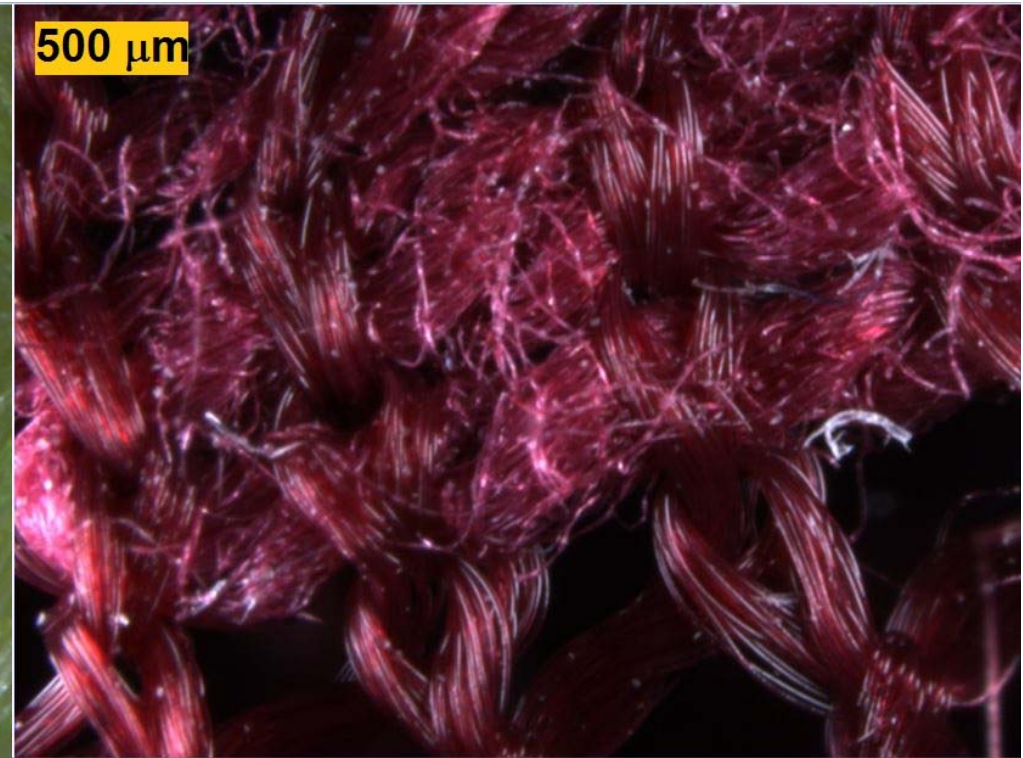


Linen

Homogeneity analysis with optical stereomicroscopy

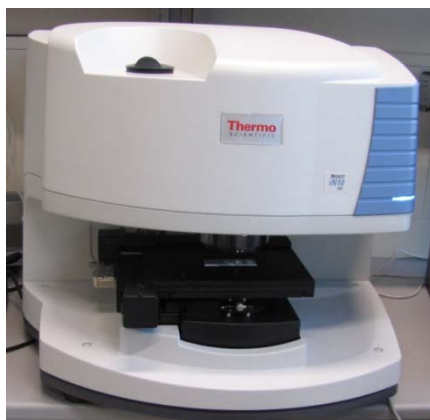
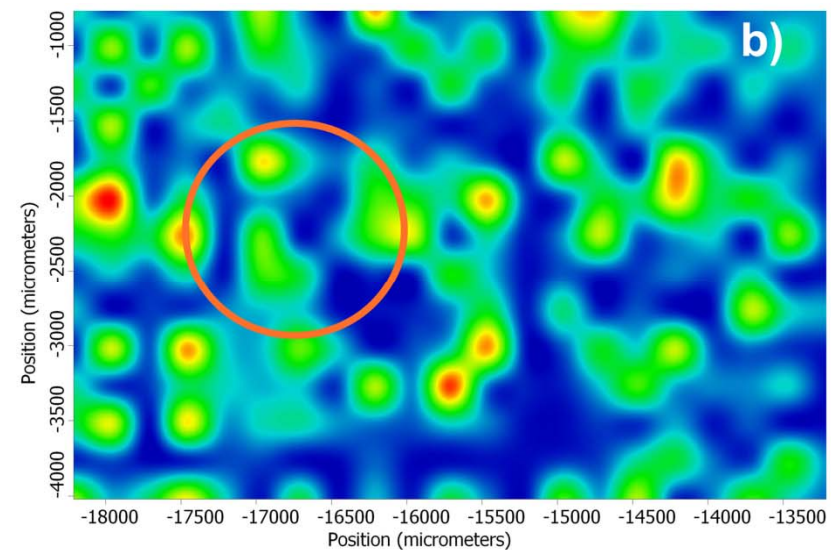
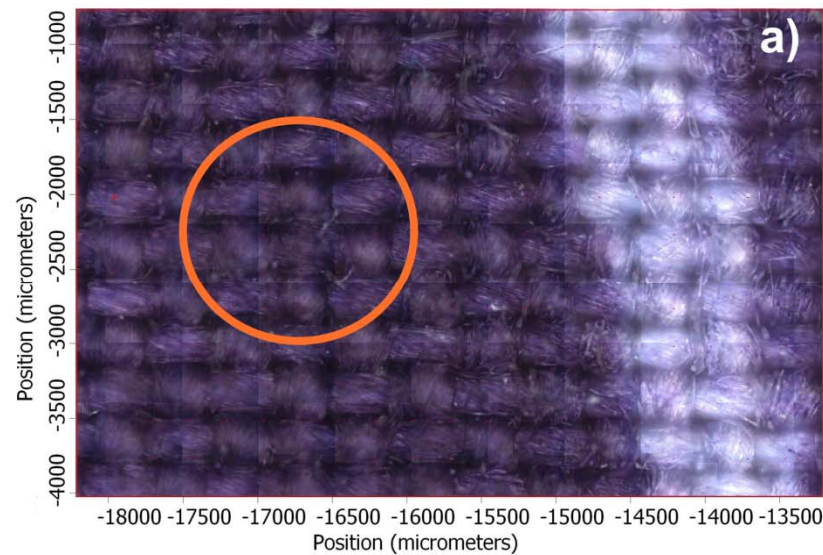


Homogeneous mixture



Inhomogeneous mixture

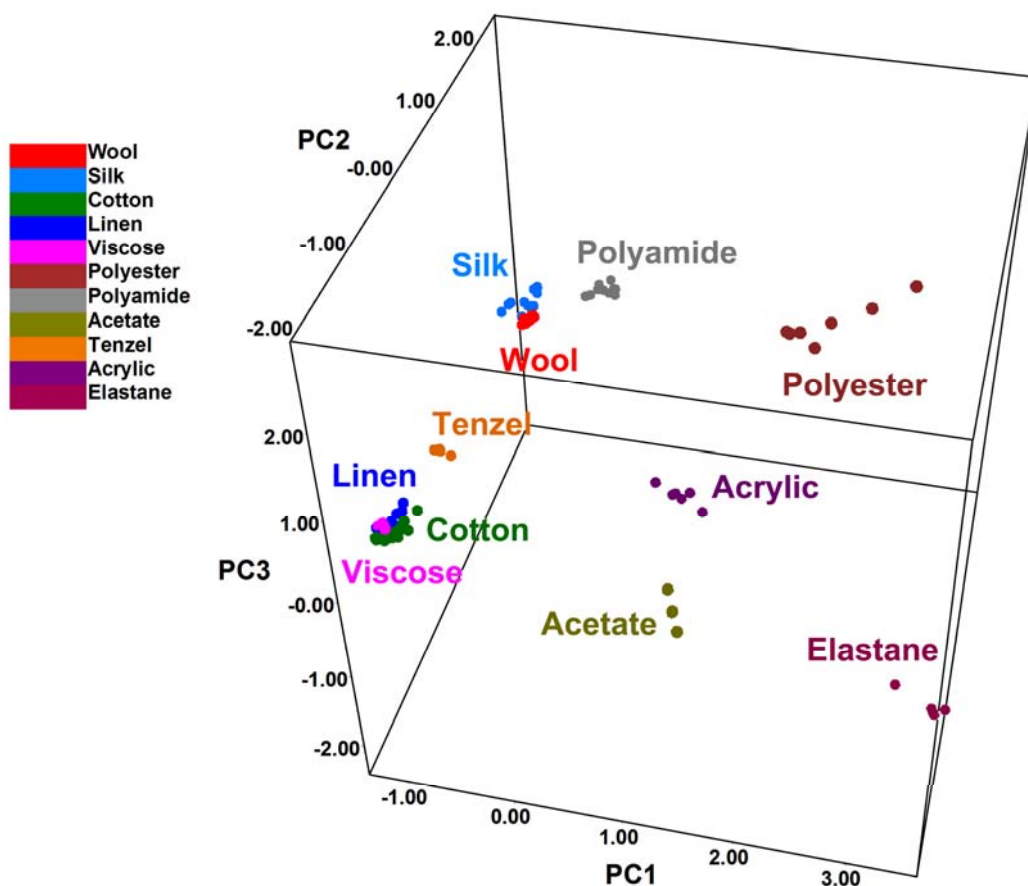
Homogeneity analysis with ATR-FTIR microspectroscopy



Polyester – cotton textile

Mapping made using ν C=O at 1714 cm^{-1}
Area 16.25 mm^2 , 294 spectra in total

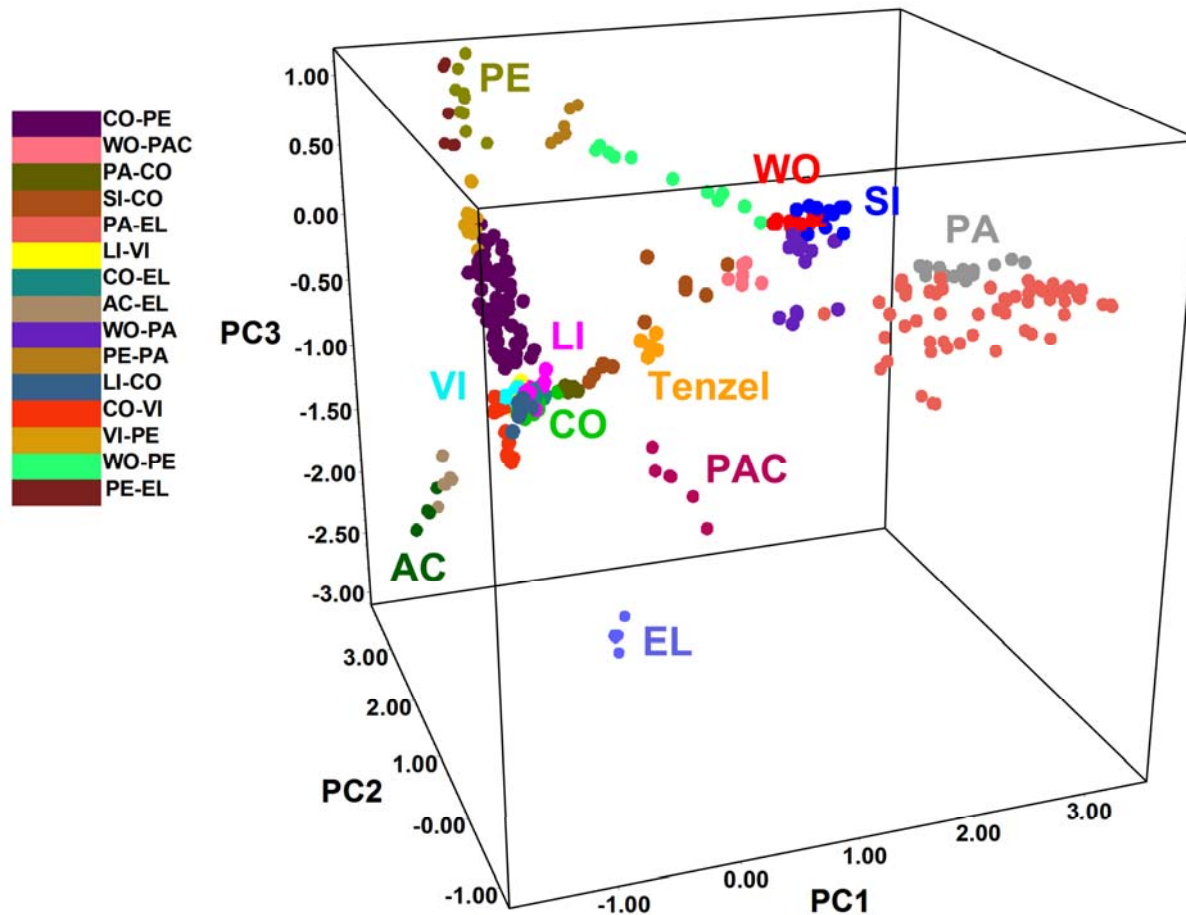
Classification of single-component fibres with PCA



- 89 spectra of 11 one-component fibre classes for creating the PCA model
- Thermo Scientific TQ Analyst Pro 9.0 software was used
- Spectral range: 250-3650 cm^{-1}

Variations described by the principal components were:
PC1 45%, PC2 31%, PC3 13%.

Classification of mixed two-component fibres with PCA



- 11 pure and 15 different binary fibres, 316 spectra in total for creating PCA model

Variations described by the principal components were:
PC1 46%, PC2 26%, PC3 18%.

Memorial chaplet from 1924



War of independence
memorial statue



Chaplet from 1924



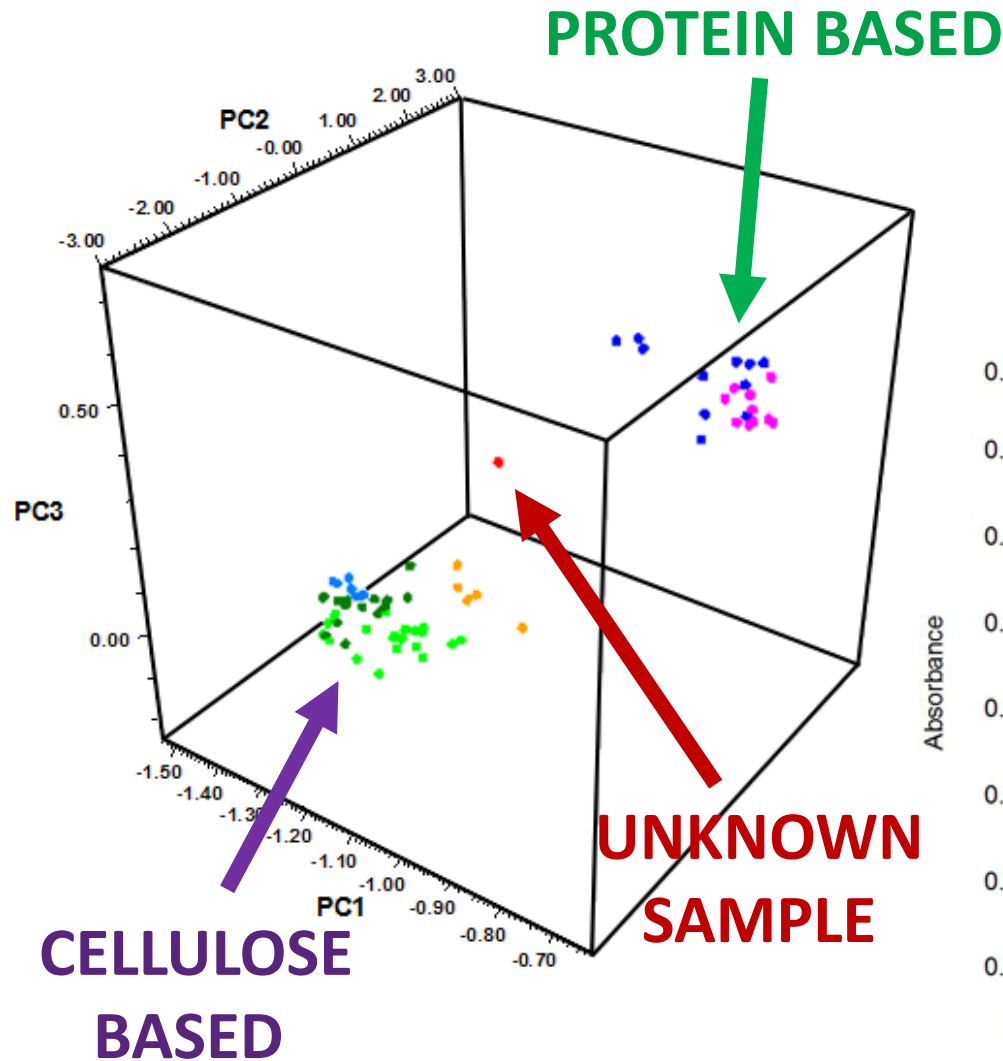
Ribbon from the chaplet



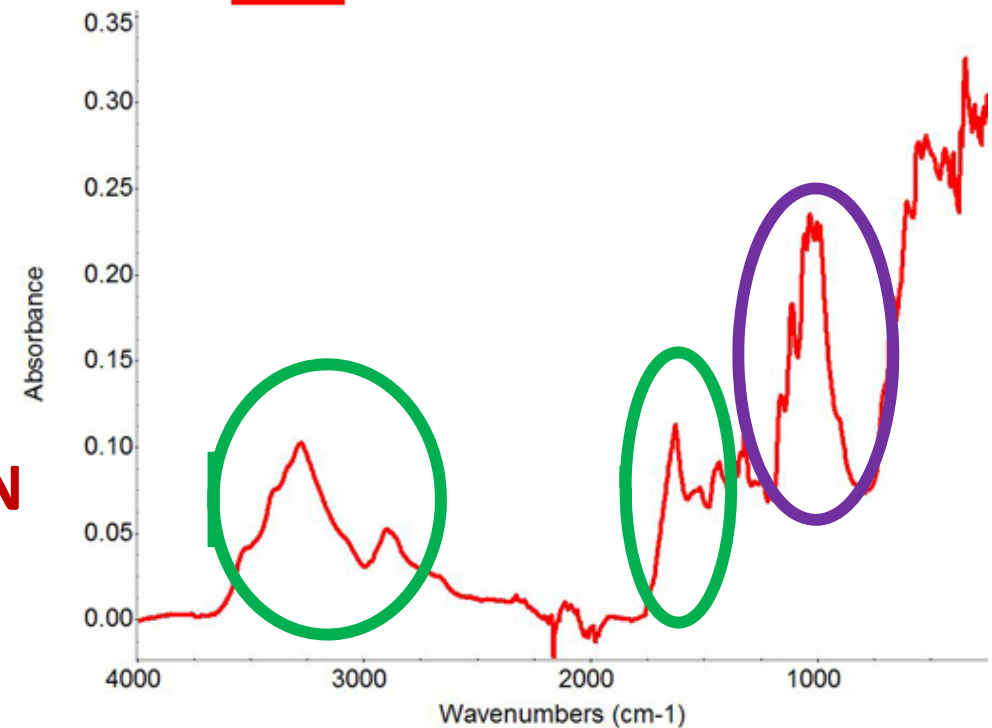
Piece for analysis

13

Piece of ribbon from memorial chaplet



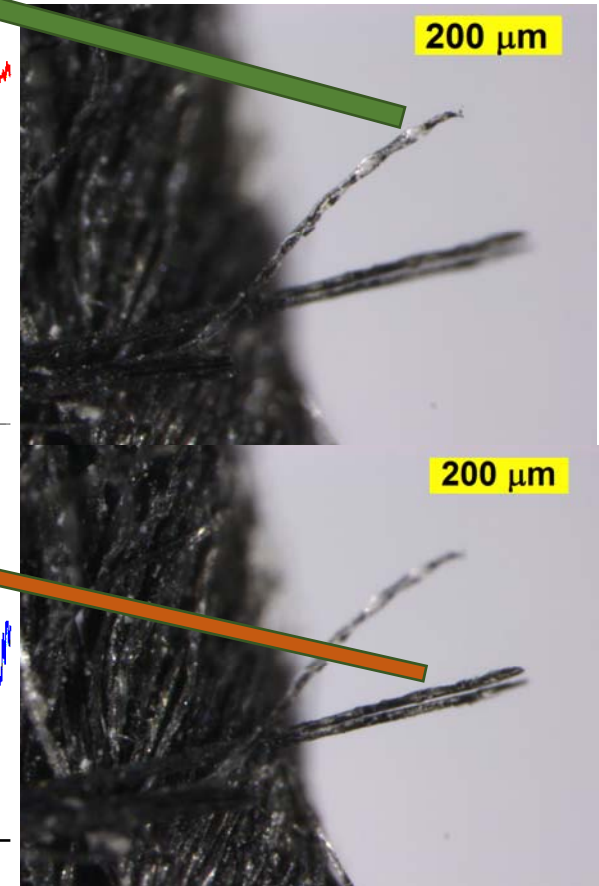
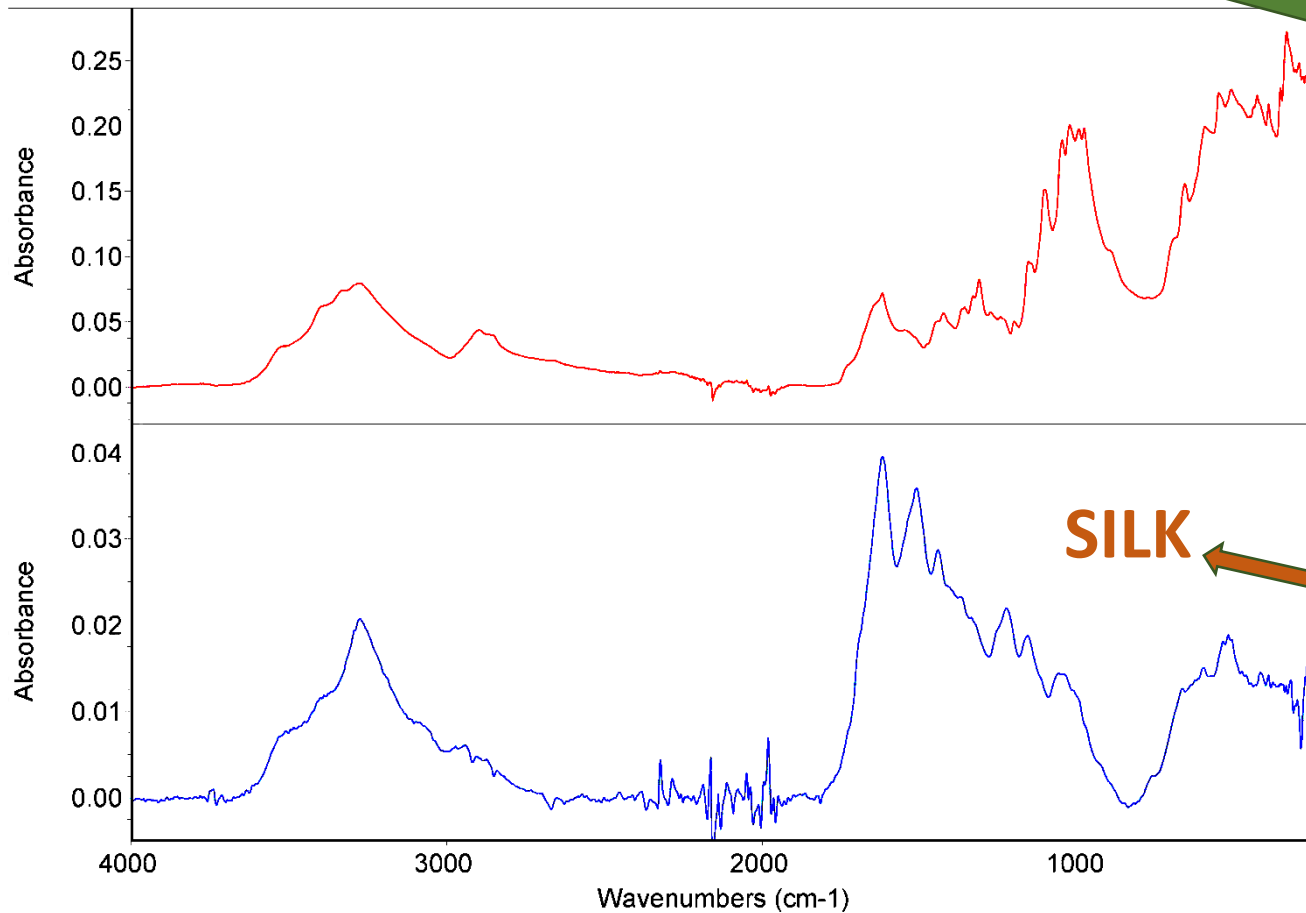
- Wool
- Silk
- Cotton
- Linen
- Viscose
- Polyester
- Polyamide
- Acetate
- Tenzel
- Acrylic
- Elastane
- UNKNOWN SAMPLE



Piece of ribbon from memorial chaplet



COTTON



Authenticity control



Conclusions



- ATR-FT-IR is quick, easy, non-destructive method
- Collection of interpreted reference ATR-FT-IR spectra
- Combination of ATR-FT-IR and optical microscope
- ATR-FTIR microspectroscopy for homogeneity analyses
- Classification to identify unknown textile samples

Acknowledgements



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Estonian National Museum



**Estonian
National Opera**

***CONSERVATION
AND DIGITIZATION
CENTRE KANUT***

Welcome to visit us:


http://tera.chem.ut.ee/IR_spectra



Database of ATR-FT-IR spectra of various materials

ATR-FT-IR spectra of conservation-related materials in the MID-IR and FAR-IR region


Home Paint components Pigment + linseed oil Coating materials Conservation materials Textile fibres Contact



Paint components

Selection of ATR-FT-IR spectra of various PIGMENTS, BINDERS and FILLERS in the MID-IR and FAR-IR region are presented.


[Read more](#)



Pigment + linseed oil

Selection of ATR-FT-IR spectra of self-made oil paints (PIGMENTS MIXED WITH LINSEED OIL) in the MID-IR and FAR-IR region are presented.

[Read more](#)



Coating materials

Selection of ATR-FT-IR spectra of self-made natural and commercial VARNISHES are presented.

[Read more](#)

This database has been described in the article "ATR-FT-IR spectral collection of conservation materials in the extended region 1000-4000 cm⁻¹" *Analytical and Bioanalytical Chemistry*, 2016, 408 (13), pp 3373-3379. If you need to cite this database then please cite this article.

Thank you for your attention!

