
Your Partner in Polymer Analytics



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Process↔Structure↔Property Relationships



receipe



process

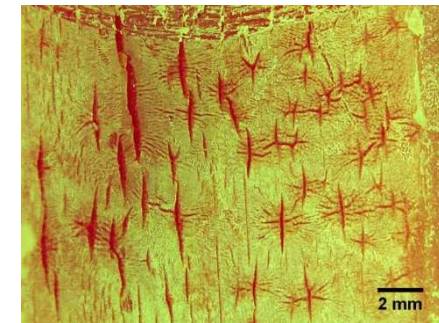
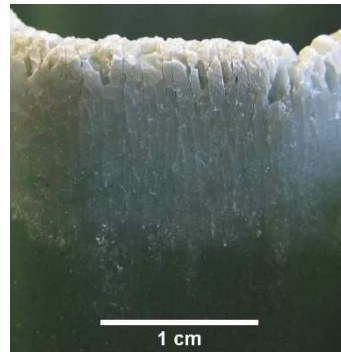


mechanical
properties

long term
properties



Failure



Seite 2

Focus areas: By technique

Separations

- Chromatography (LC)
- Field Flow Fractionation (FFF)
- CRYSTAF, TREF, CEF

Thermal

- DSC
- TGA
- Pyrolysis GC-MS

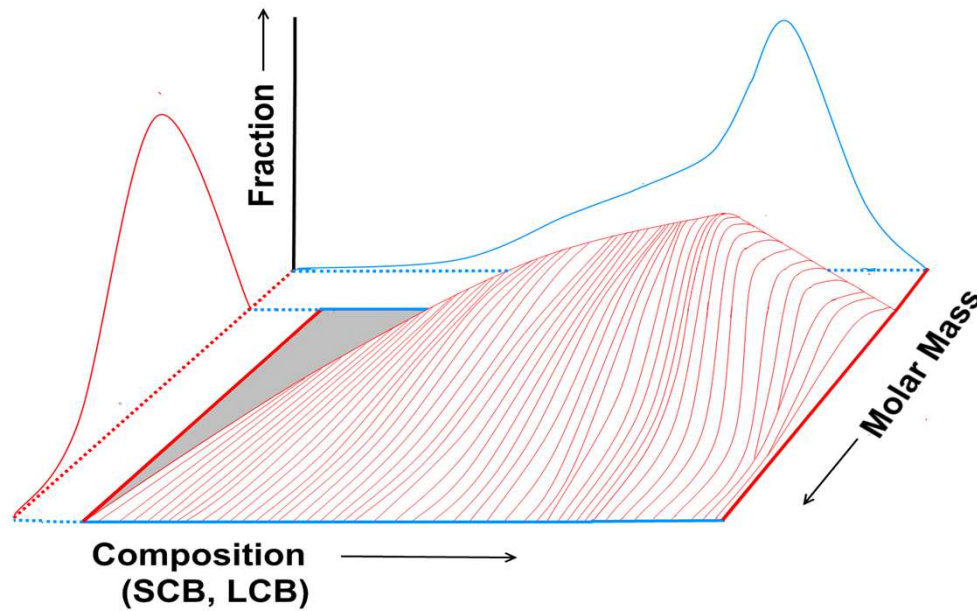
Spectroscopy

- Infrared
- Raman
- NMR

Imaging

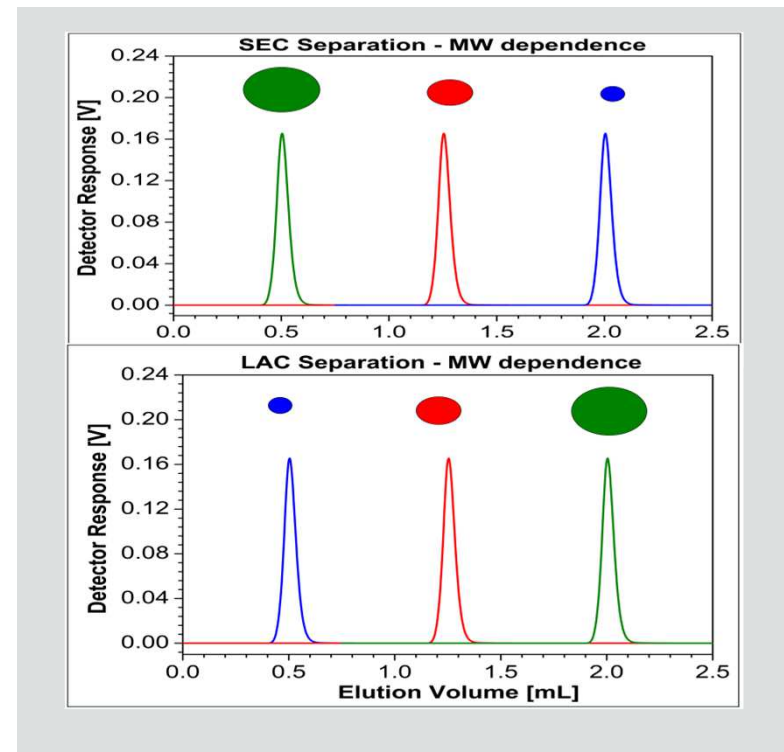
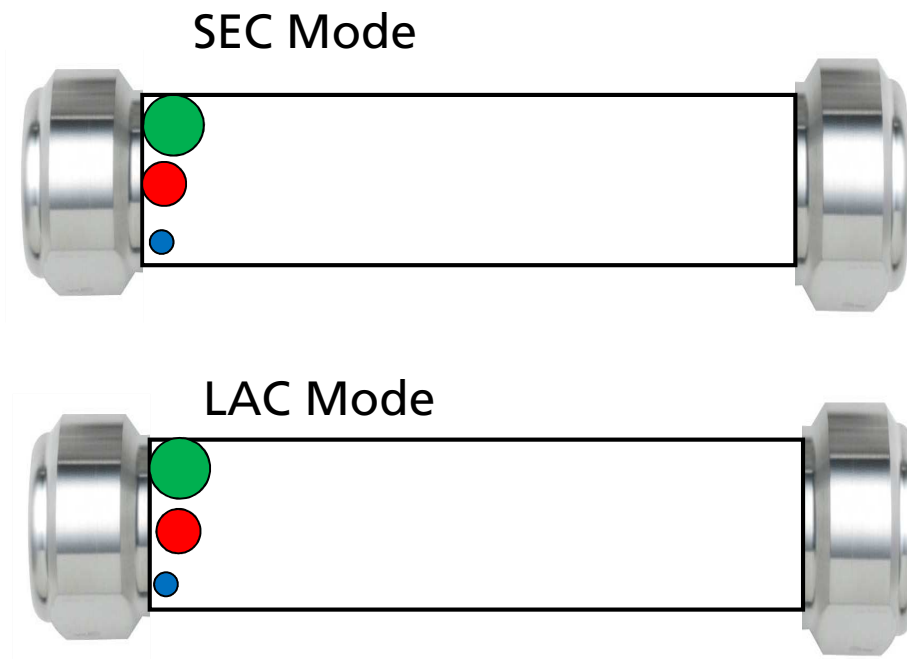
- Infrared-microscopy
- Raman-microscopy
- Polarized light microscopy

Separation techniques



- Multidimensional Techniques are essential to analyze the chemical heterogeneity

Separation modes in liquid chromatography



Multidimensional HT 2D-LC



Sample Preparation

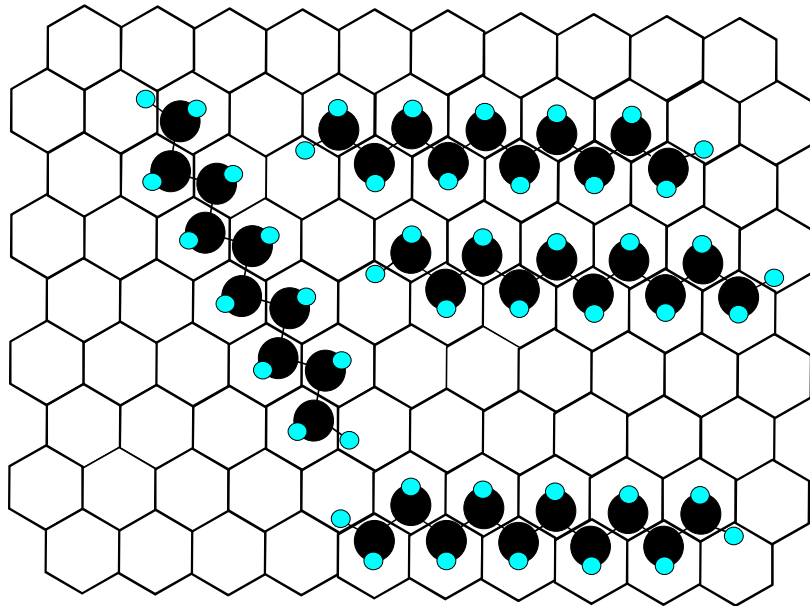
**Heatable
Separation
unit(s)**

Detection



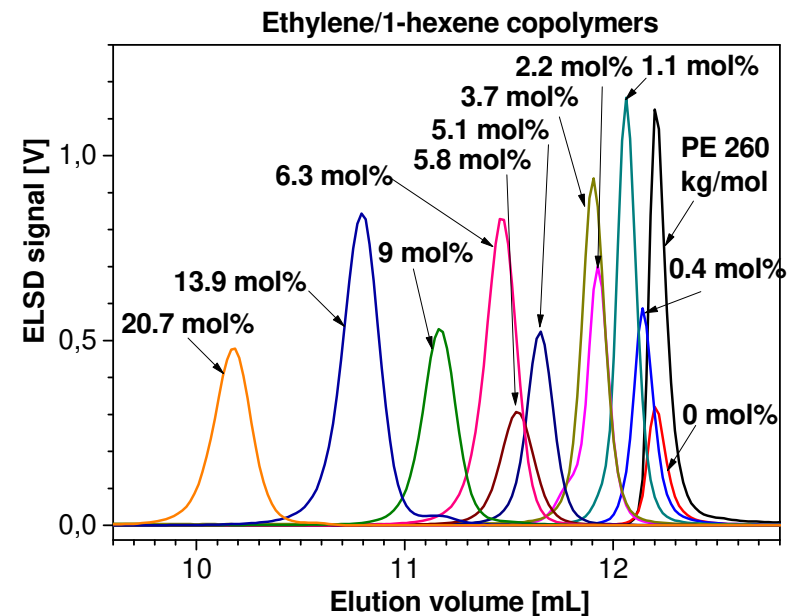
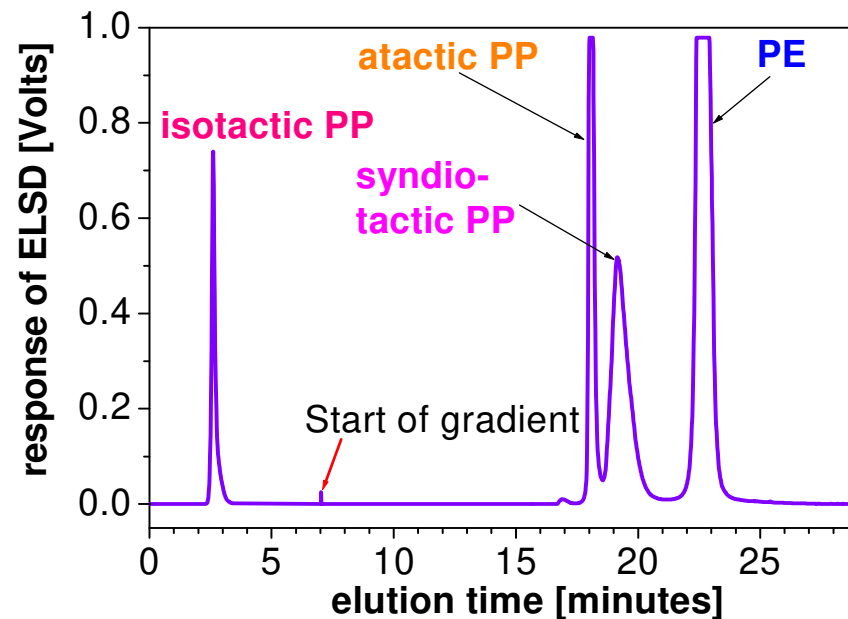
**IR
Raman
ELSD
NMR**

Graphite – A magic stationary Phase



- Absolutely flat surface
- Interactions with the analyte through the full range of electronic interactions

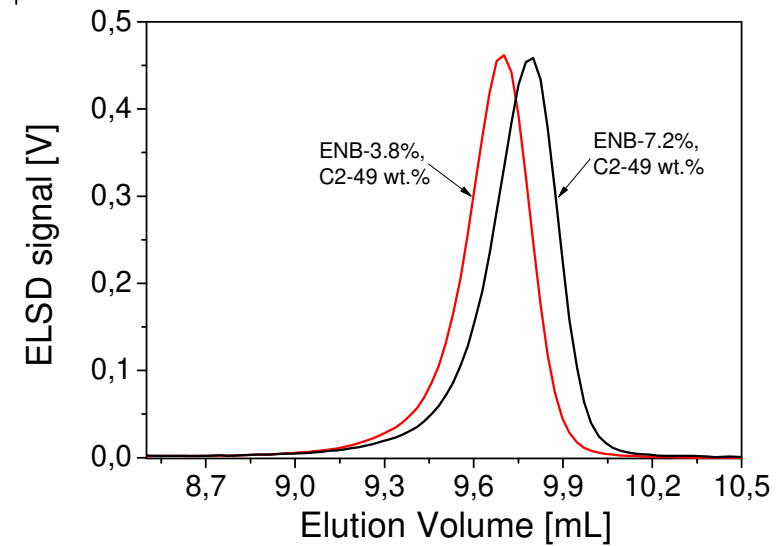
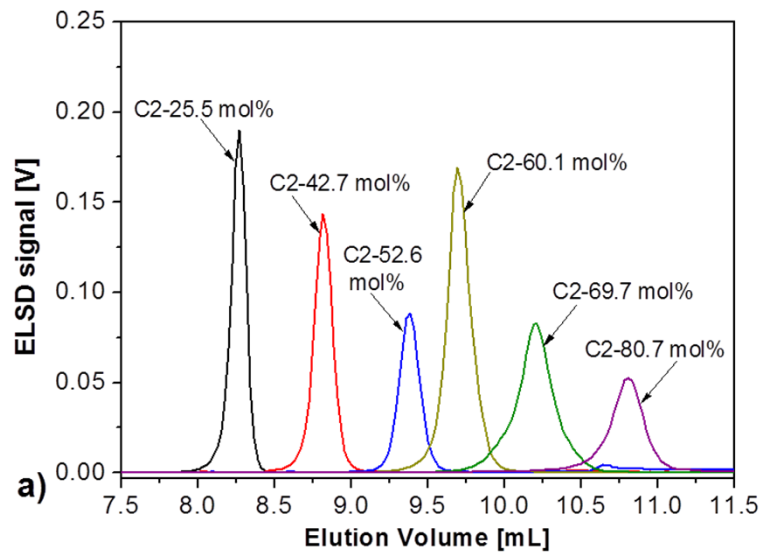
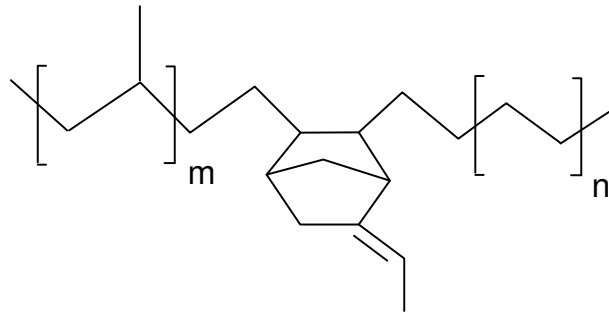
Interactive Chromatography up to 200 °C



- Highly selective interactions according to composition and microstructure become possible

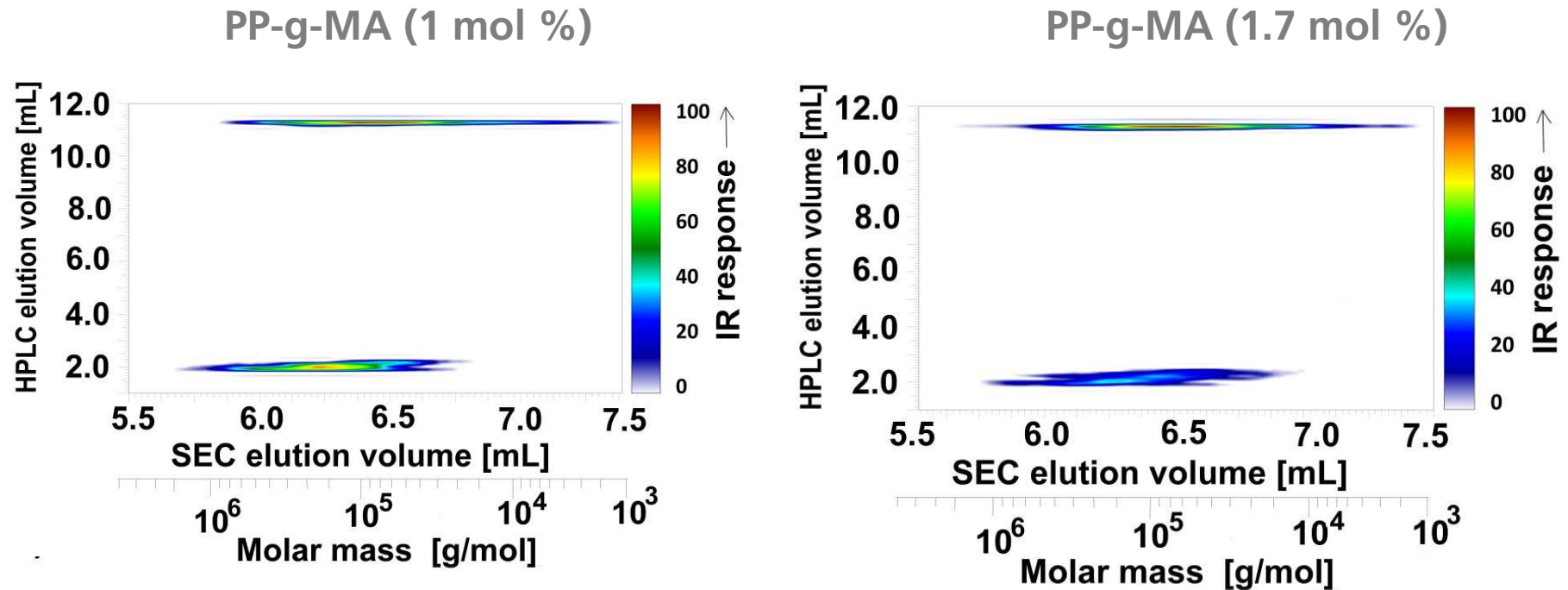
Stationary phase: Hypercarb™, Mobile phase: decanol→TCB

EPDM



- Separation according to ethylene content and diene content are possible

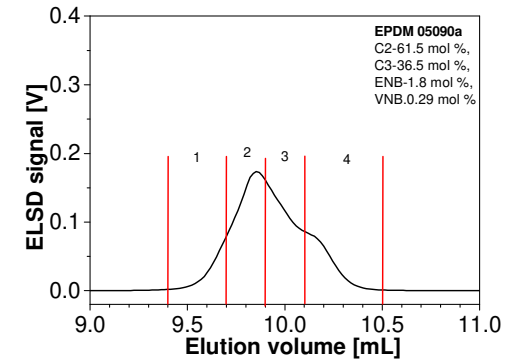
HT 2D-LC-IR of Grafted Polyolefins



- Graft products can be separated from non-grafted material
- The molar mass distribution of each component can be determined
- The graft heterogeneity becomes visible

Steps for LC → NMR, FTIR and UV/RI (off-line)

Sample → LC-ELSD →



Replace ELSD by portable automatic fraction collector

From LC →



Automatic fraction collector
Temperature range 25 – 200 °C



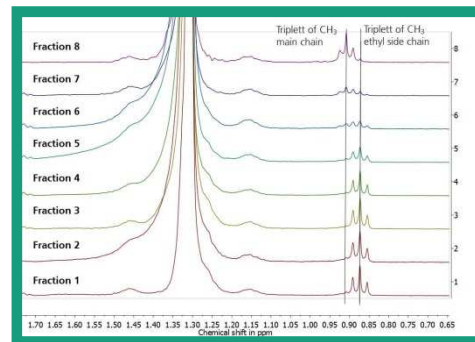
Sample holder



Evaporator with
vacuum pump



After evaporation of
solvents



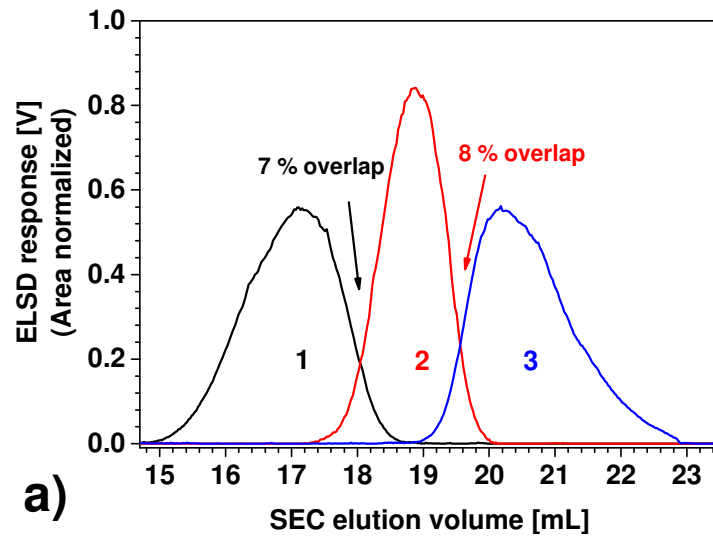
NMR



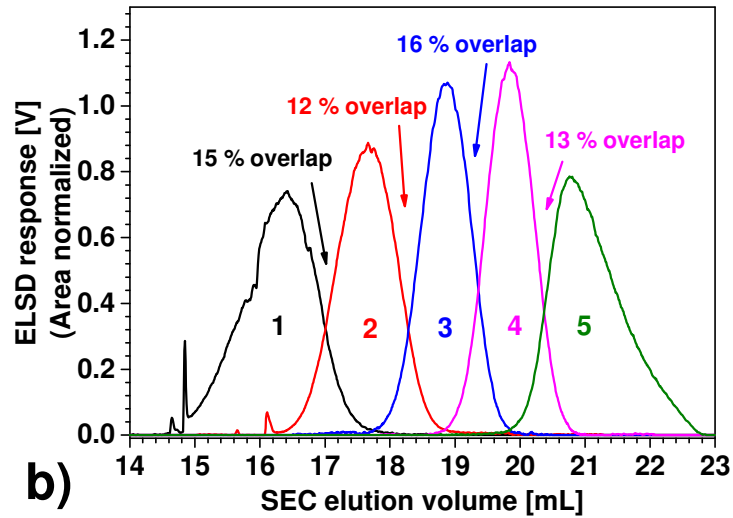
Transfer to NMR tube

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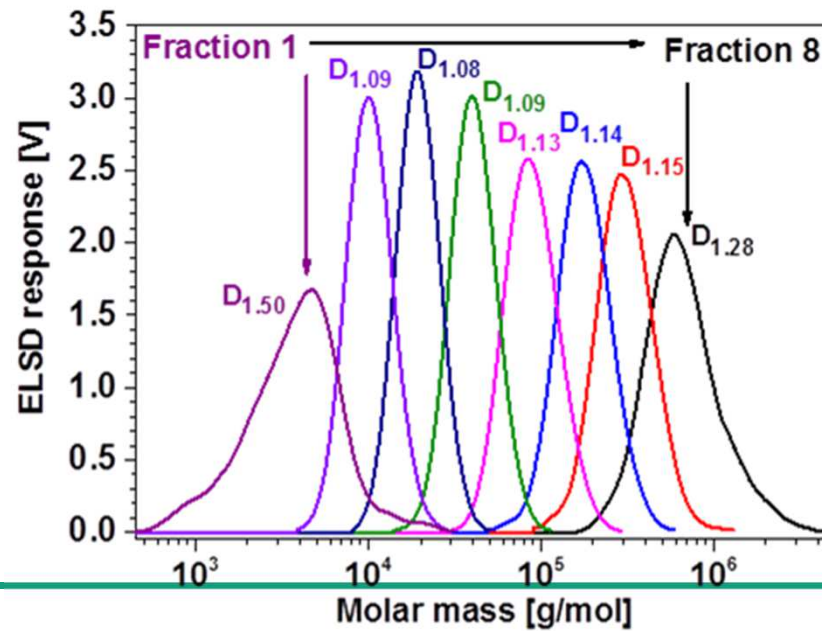
Preparative LC



3 fractions



5 fractions

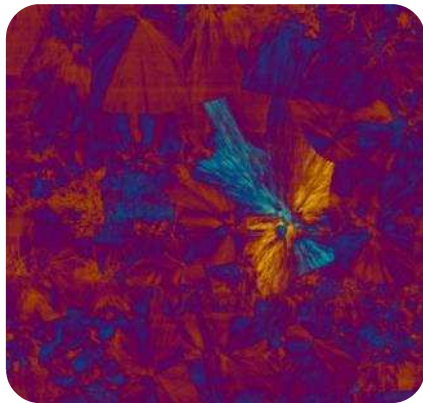


8 fractions

The world of imaging at LBF

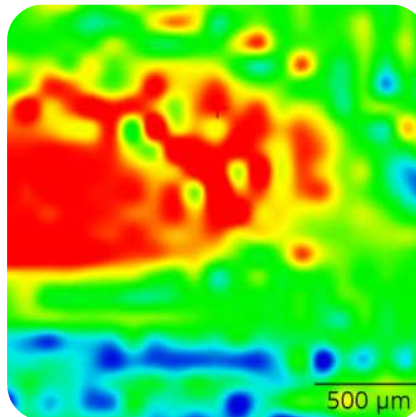
Polarized Light

- Morphology
 - Crystallinity
 - Orientation
 - Polymorphism



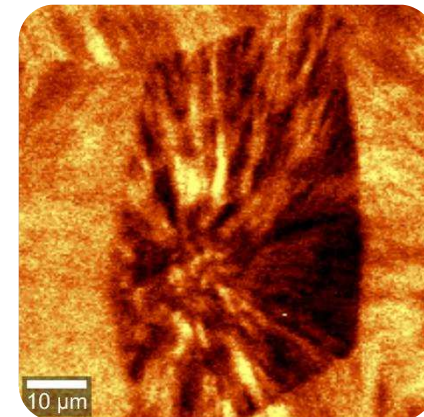
Infrared

- Morphology
 - Crystallinity
 - Orientation
- Additive
 - Content
 - Distribution



Raman

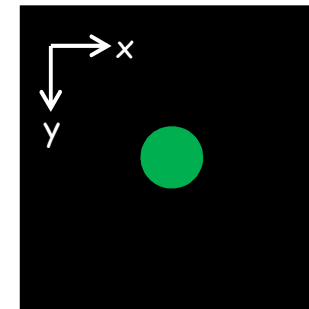
- Morphology
 - Crystallinity
 - Orientation
 - Polymorphism
- Additive
 - Identification
 - Distribution



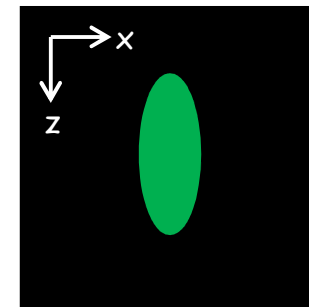
Confocal Raman microscopy (CRM)



Confocal Volume



266 nm



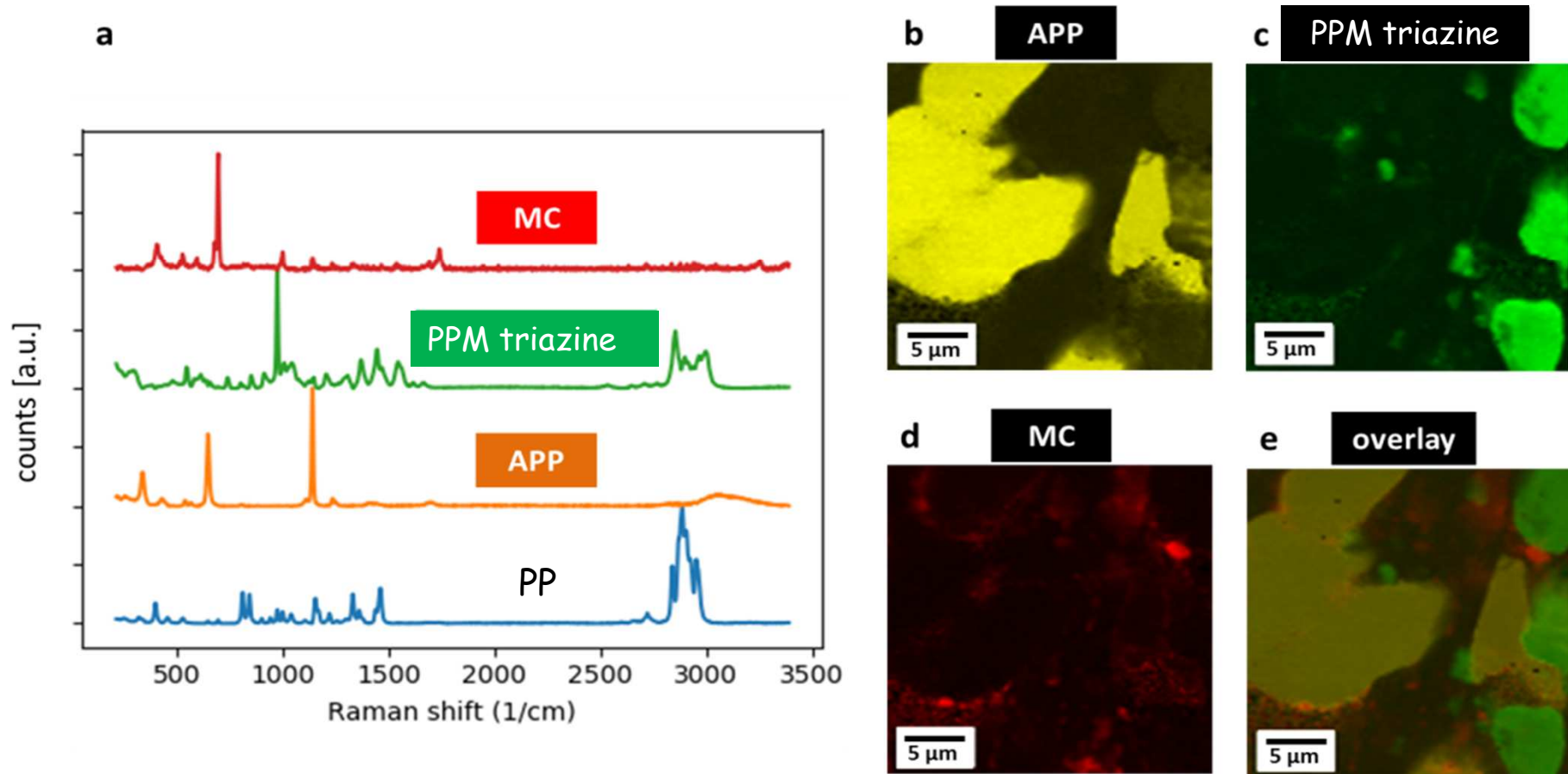
850 nm

Alpha 500 Confocal Raman Microscopy, WITec, Germany

Flame Retarded PP (FR PP)

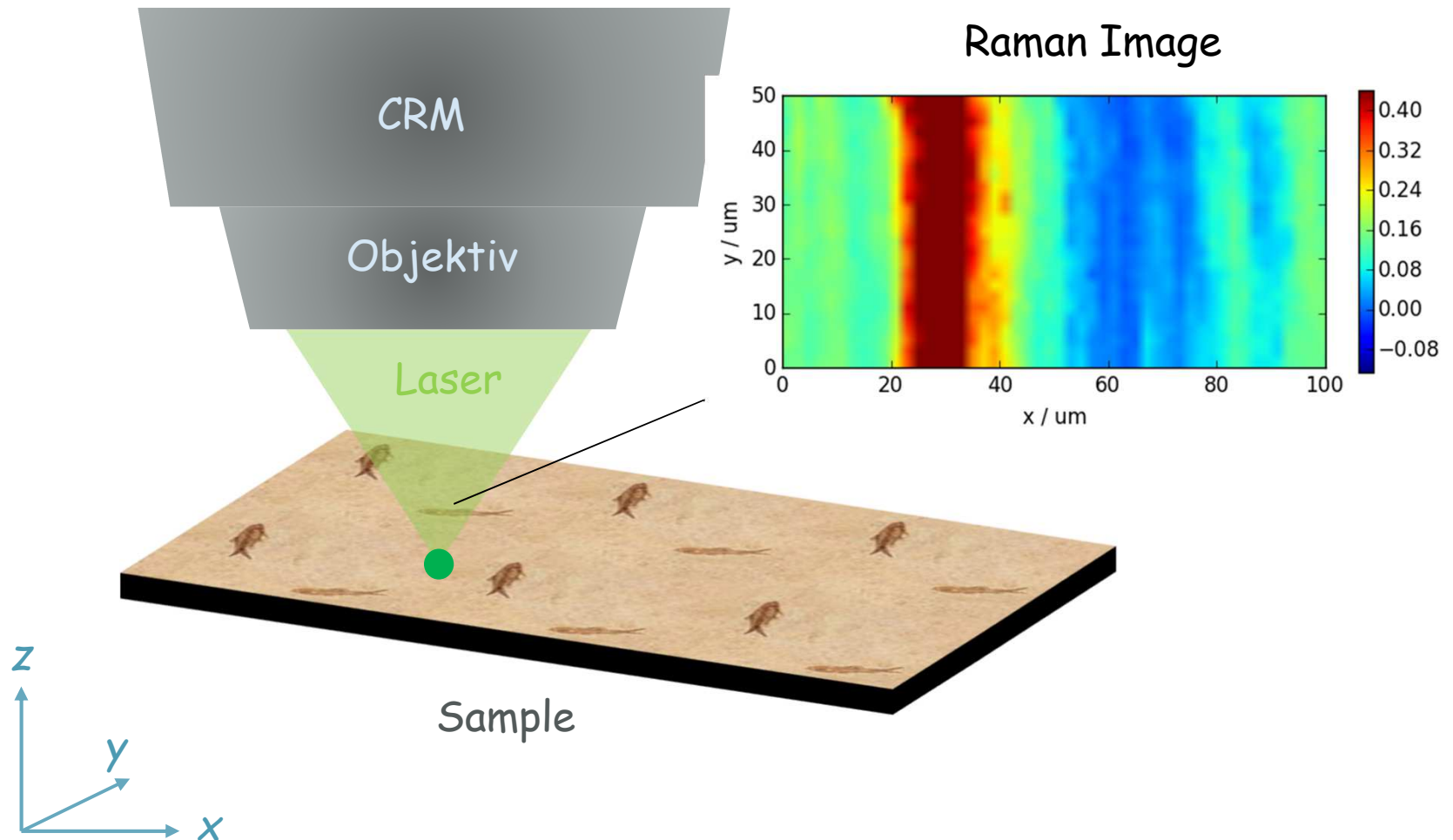
Cross section of FR PP

Raman-image of von 25x25 μm^2 with 100x100 pixels

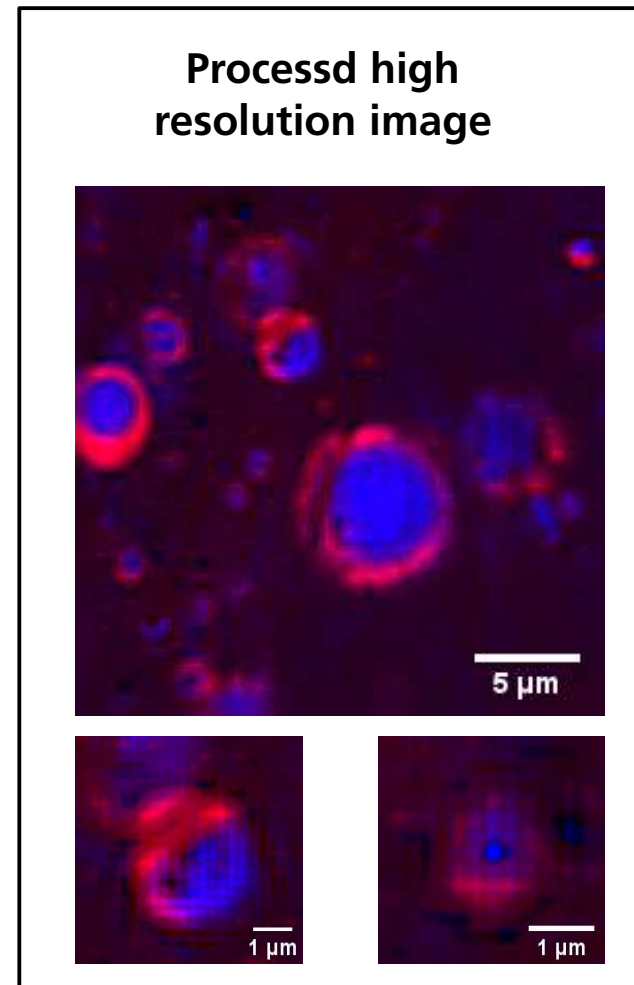
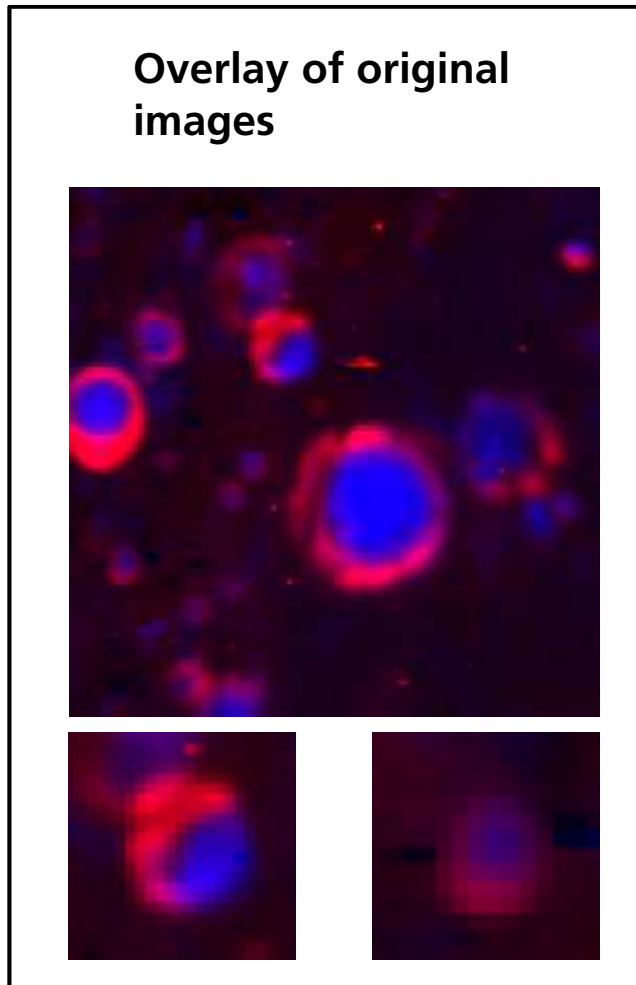


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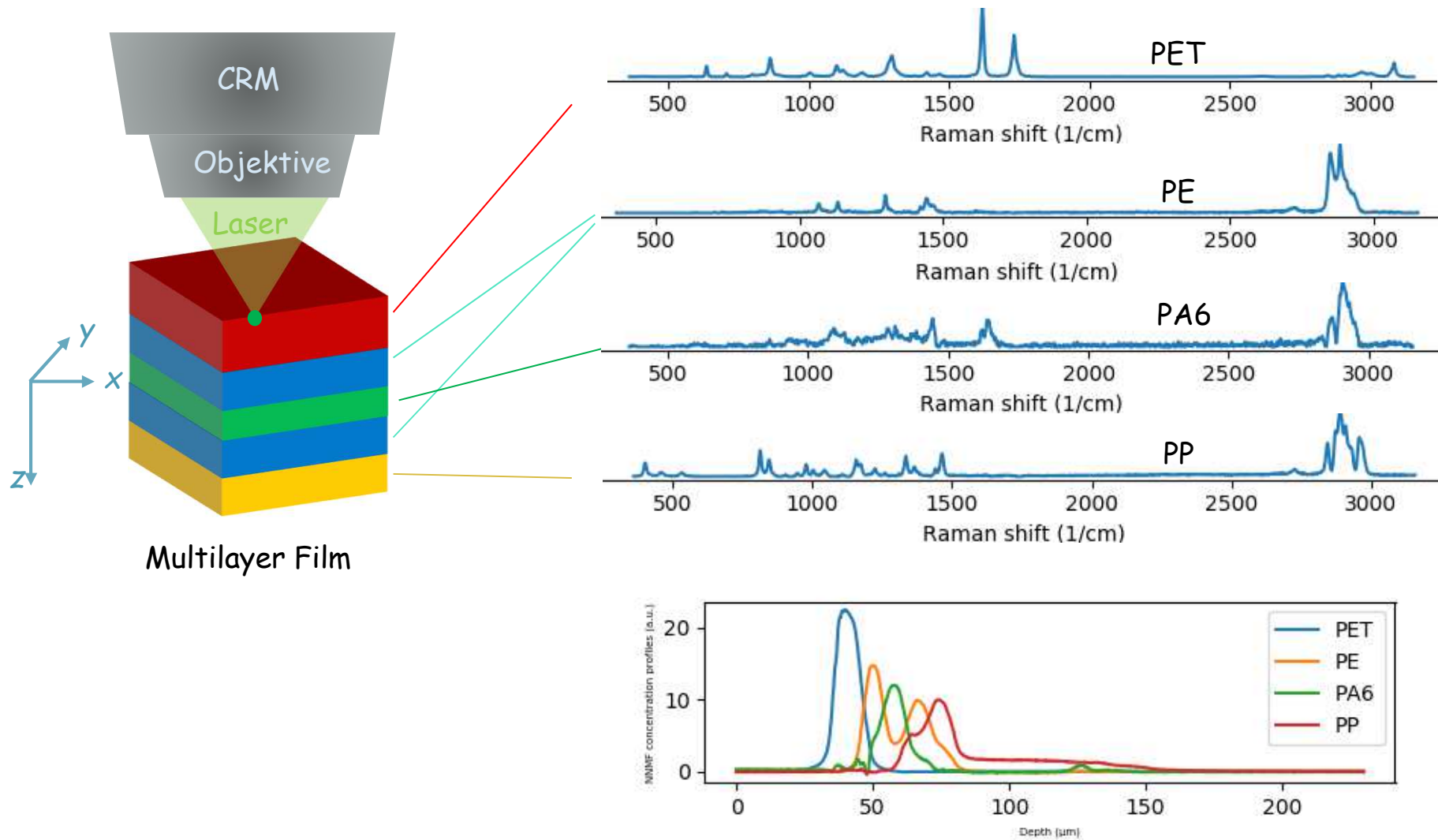
How does CRM work?



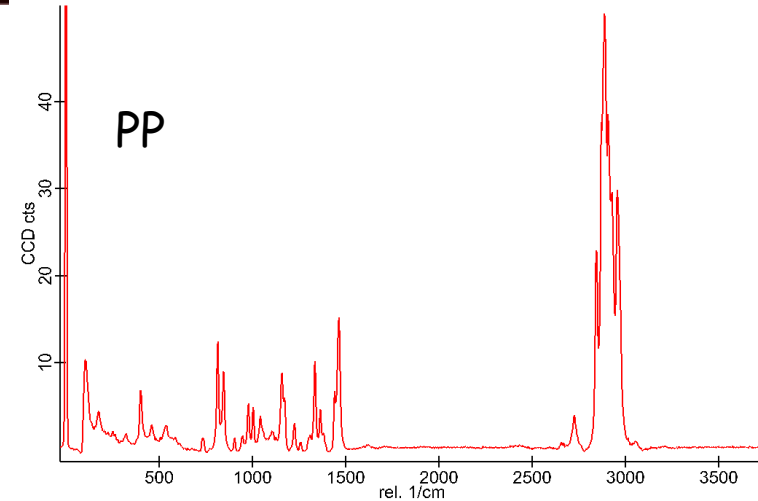
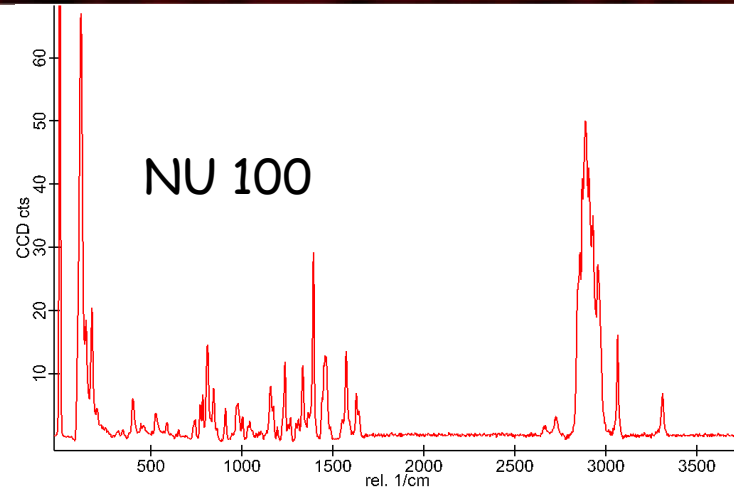
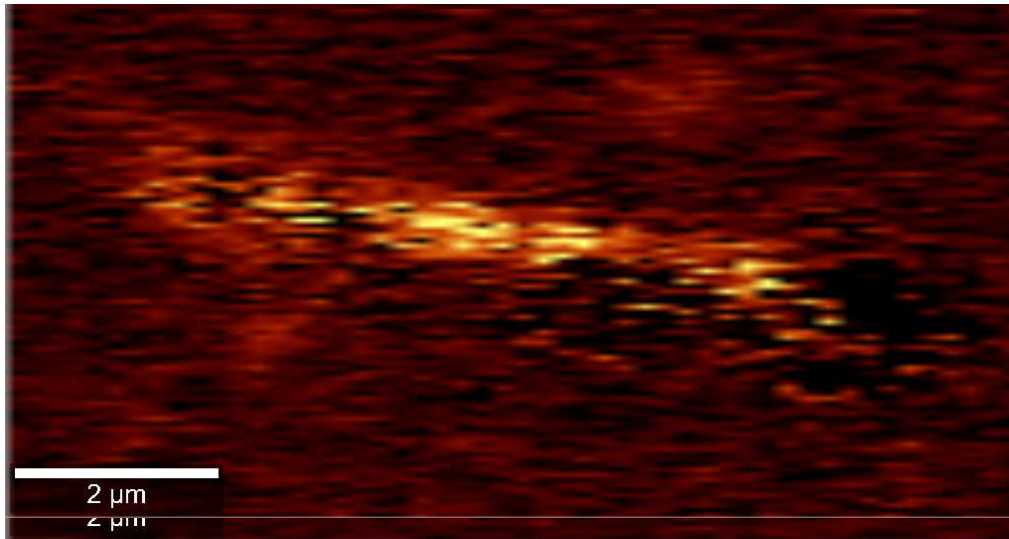
High Resolution CRM of Core-Shell Particles in POM



CRM: Depth Profiling

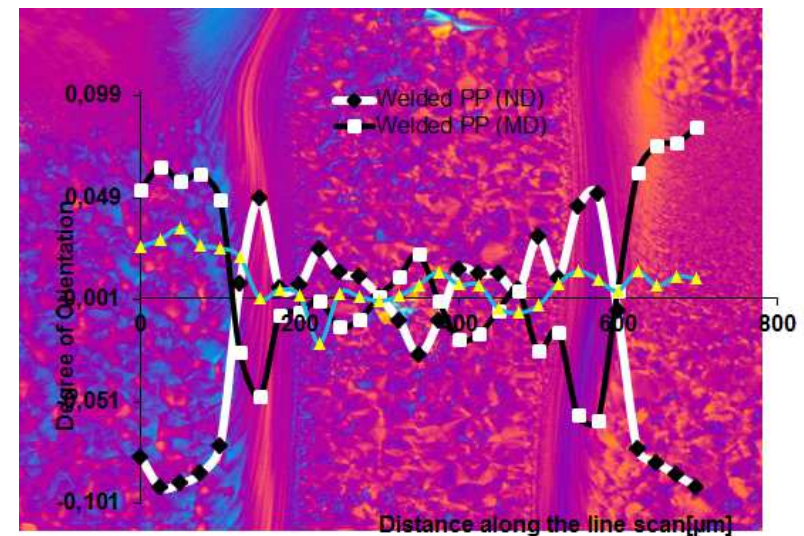
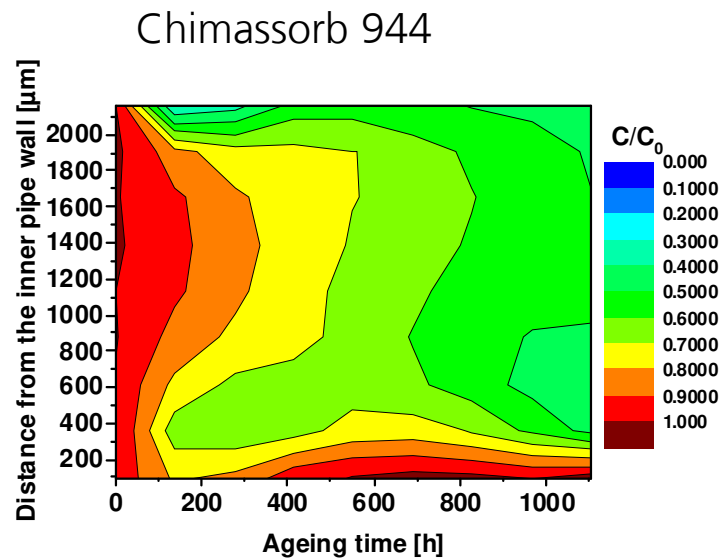


Volume mapping of additives



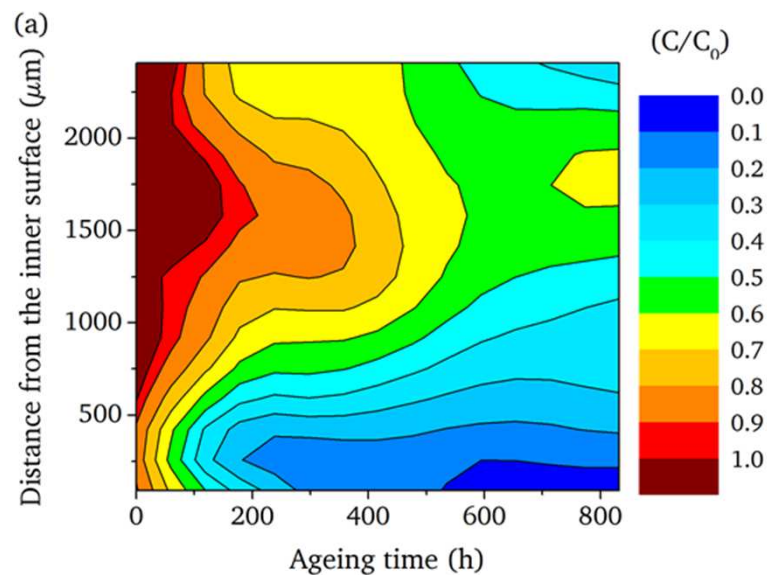
Infrared Imaging

- μ FTIR:
 - Line Scan, Area Map
- Applications
 - Additive distributions
 - Time and space resolved
 - Morphology distributions

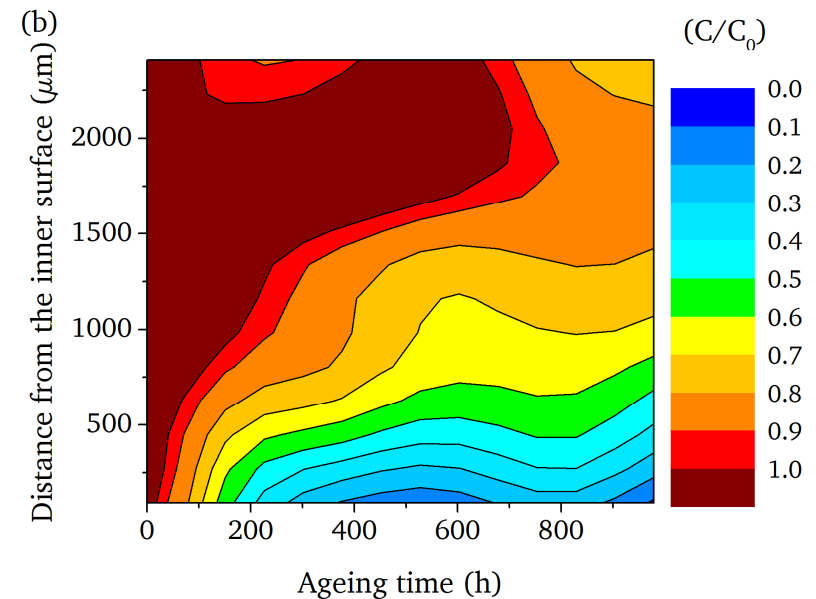


Effect of Chlorinated Water on iPP-R Pipes

PP-R 1



PP-R 2



Chlorine (4 mg/l), 95 °C

- The time and space dependent concentration of stabilizers can be mapped

■ What can we do for you?

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