Top Analytica Ltd.

MIICS 2010, Mikkeli 17-19.3.2010

Problem solving by surface and micro analysis

Jyrki Juhanoja
Top Analytica Ltd

Top Analytica Oy Ab

Surface analyses and consulting

- Commercial analytical service laboratory in Turku
- Specilized in surface and micro analysis
- Founded 2001, 7 employees
- Turn over 2008: 630 000 €
- Analyses, problem solving and consultig in material and surface
- Key customers chemical, pulp and paper, metal and process industries

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Our services and typical samples

- Annual contracts: allows the customer to use our instruments with own personnel
- Individual work orders: trouble shooting, quality control, reverse engineering etc.
- Projects: Long term R&Dprojects together with customer

  - Metals & steels
  - Ceramics & glass
  - Minerals
  - Inorganic materials
  - Deposits & impurities
  - Polymers
  - Paper
  - Coatings
  - Pharmaceutical materials

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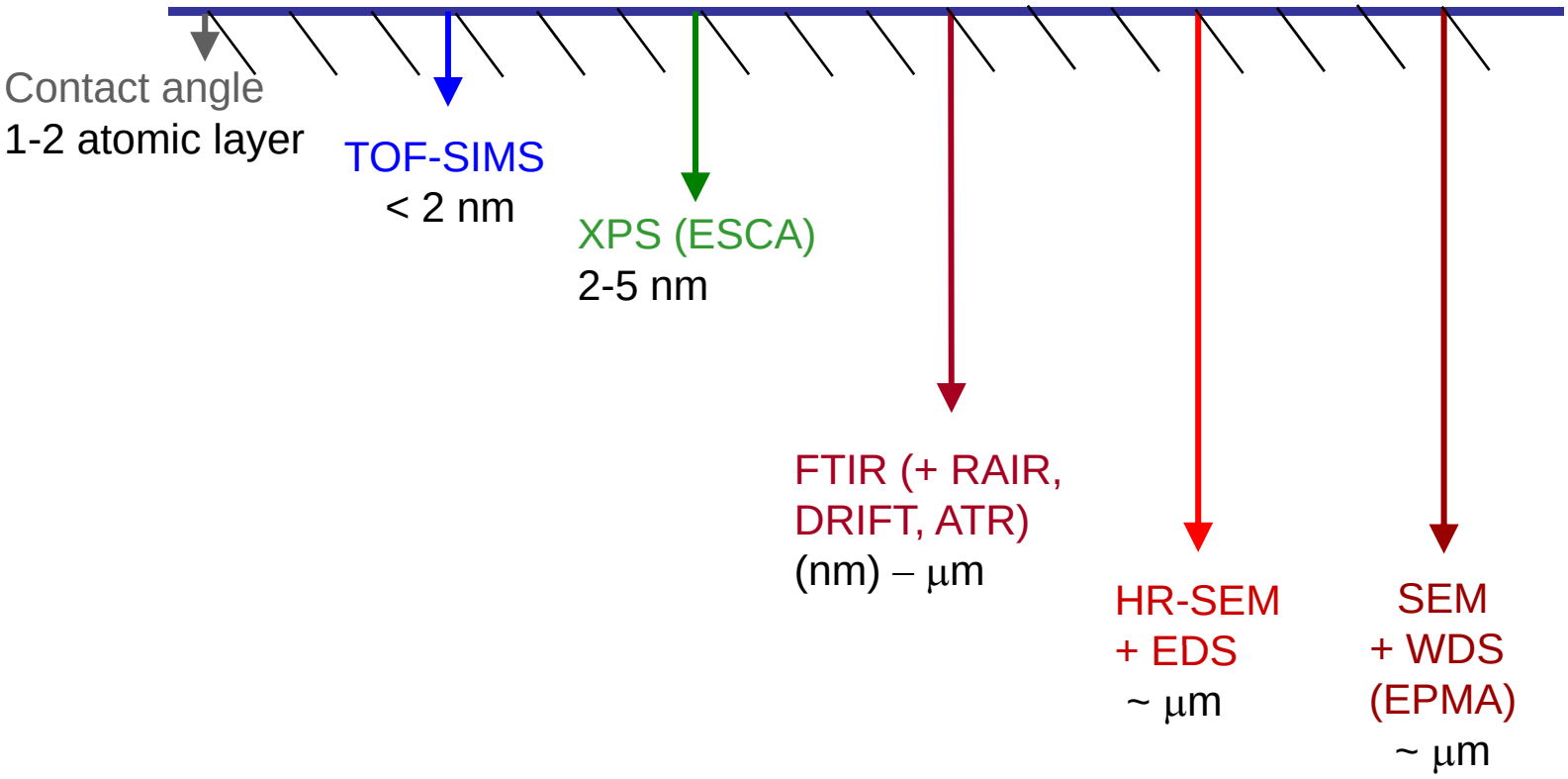
Analytical instruments



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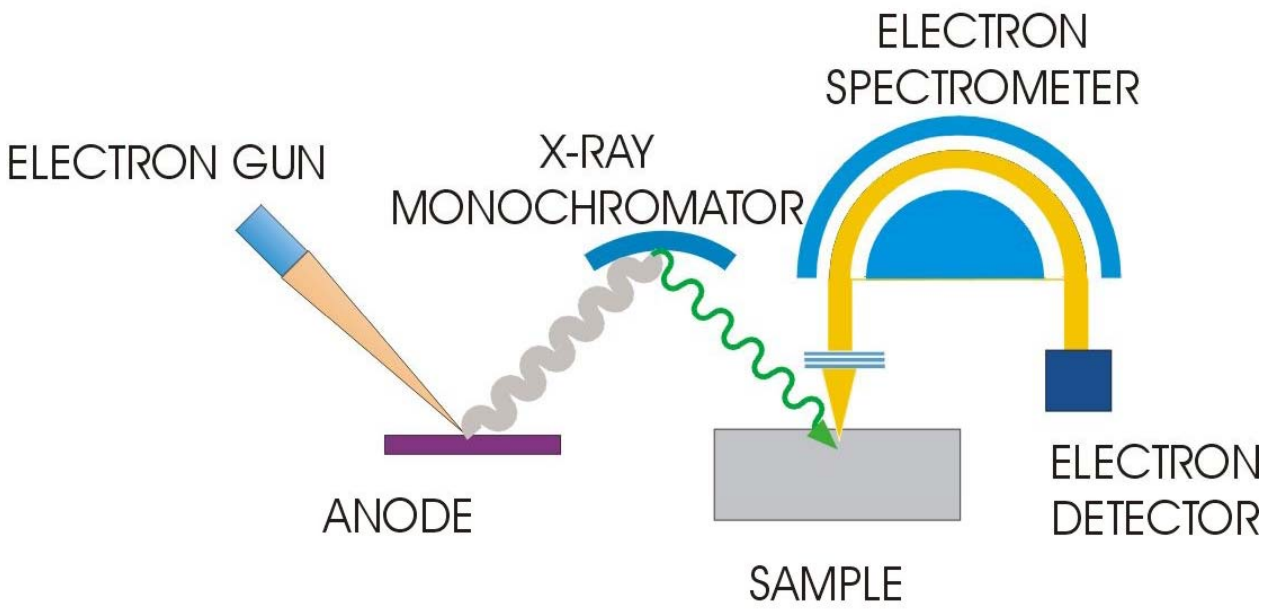
Microprobe ESCA (XPS)



- **Qualitative and quantitative analysis of elements (except H and He)**
- **Analysis area ø about 10 µm, analysis depth 5-10 nm**
- **Depth profiles (composition as a function of depth)**
- **Chemical shifts (oxidation states, chemical bonds for organic samples)**
- **Mapping**

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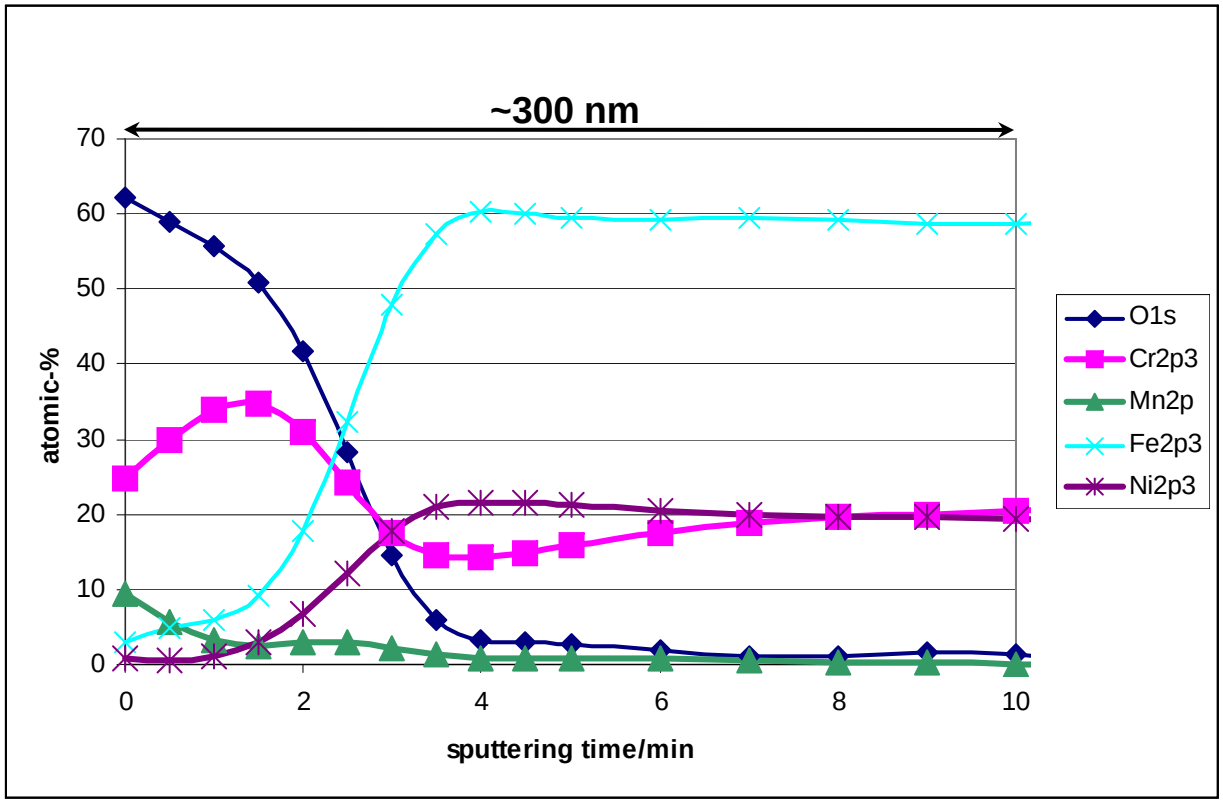

Depth profile of the oxide layer formed on steel surface during high temperature oxidation

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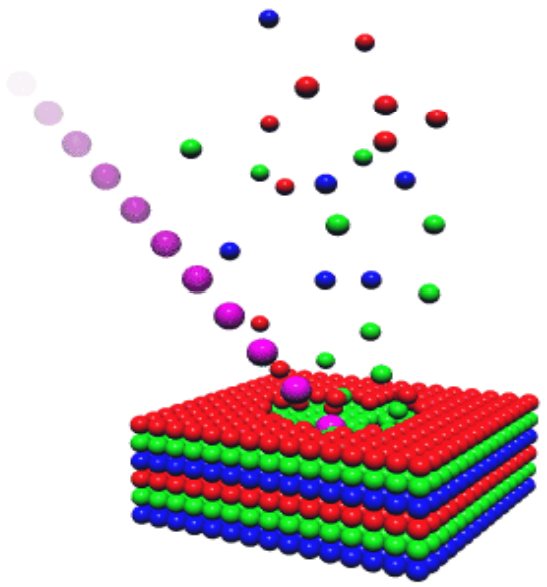
Time of Flight Secondary Ion Mass Spectroscopy (ToF-SIMS)



- detection of all elements
- chemical information (molecules, fragments, clusters)
- high lateral resolution
- low detection limit (ppm-ppb)
- small information depth
- destructive

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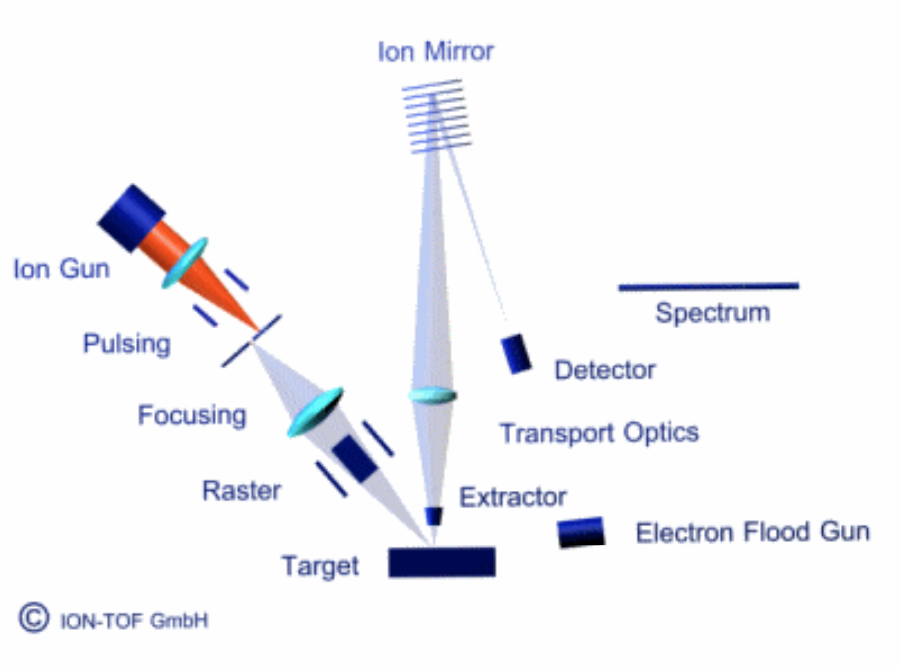
TOF-SIMS

Instrumentation



- high sensitivity (parallel detection)
- high mass resolution (> 10000)
- high lateral resolution (100 nm for elements, 1000 nm for molecules)
- high mass range (< 10000 Da)

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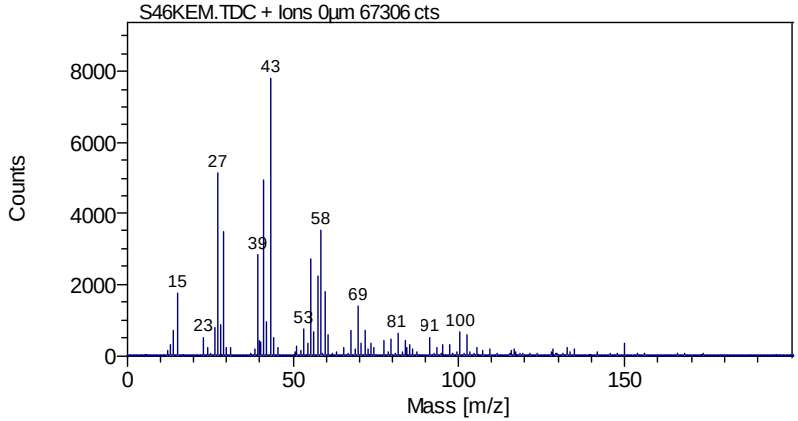
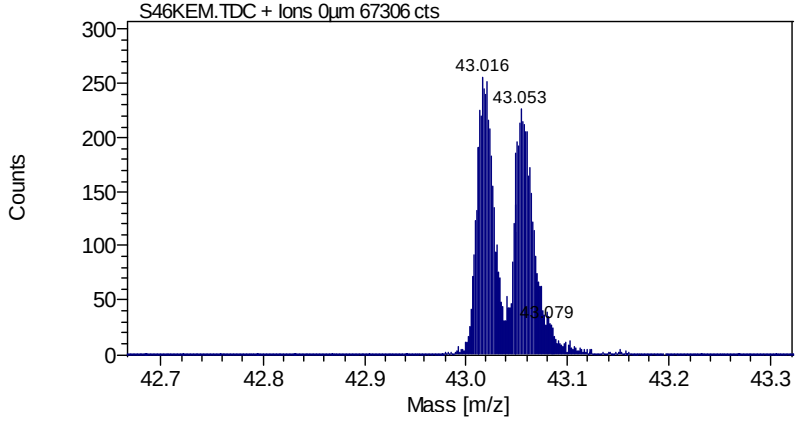
TOF-SIMS

Modes of Operation Surface Spectroscopy





- elemental and molecular information
- analysis depth 2-5 nm
- ppm sensitivity (for elements)
- mass resolution >10 000
- huge differences in sensitivity for different elements or molecules
- quantification possible only with standards with similar composition

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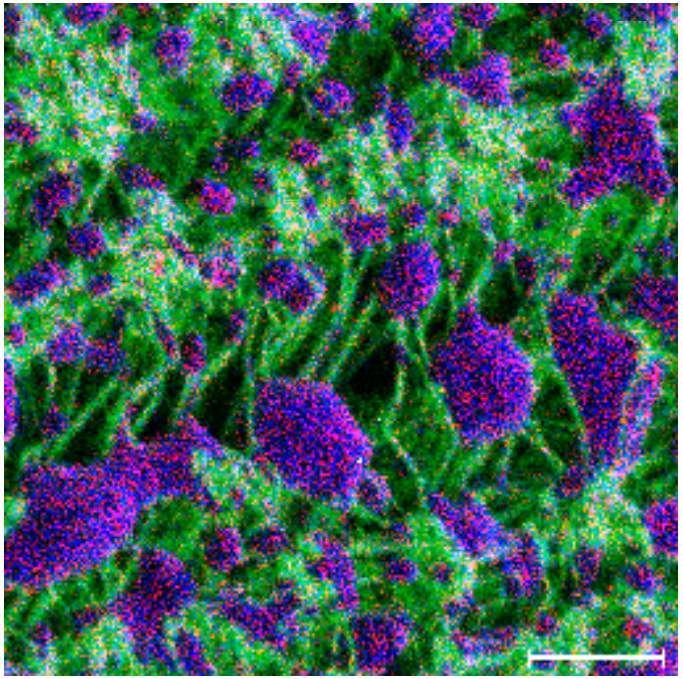
Molecular mapping of the surface



Aerosol particles collected on teflon filter
F=green, SO4=blue, fatty acids=red,
scale bar =1µm

- lateral resolution < 500 nm
- parallel detection (=fast mapping)
- raw-file measurements
- for insulating samples charging limits the resolution
- for organic samples the material is destroyed by ion dose, which limits the resolution

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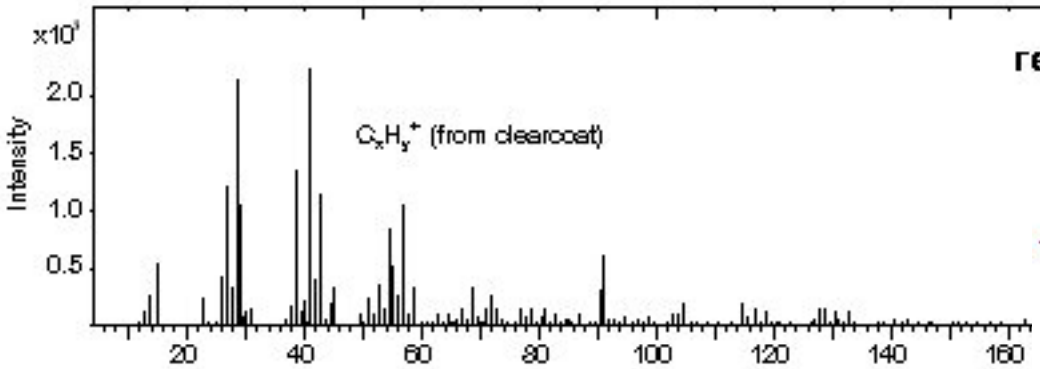
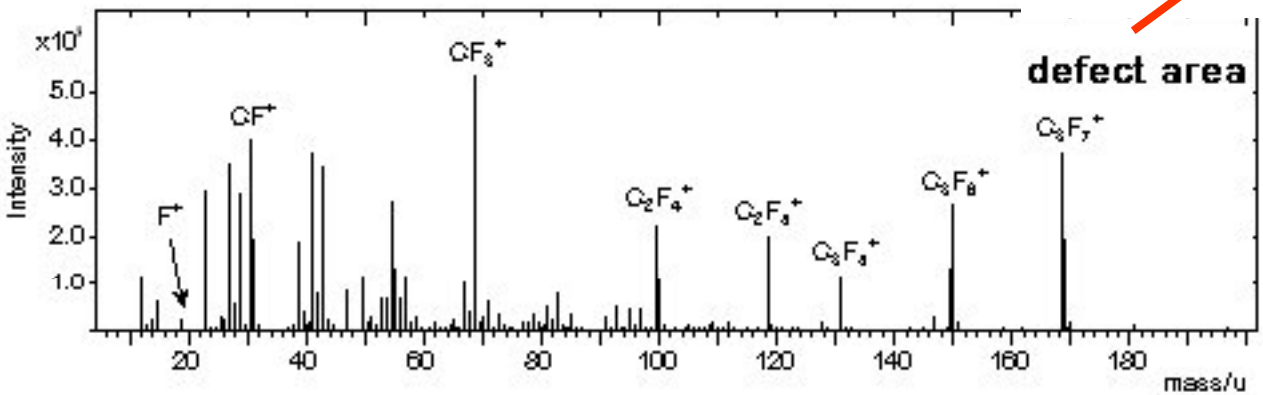
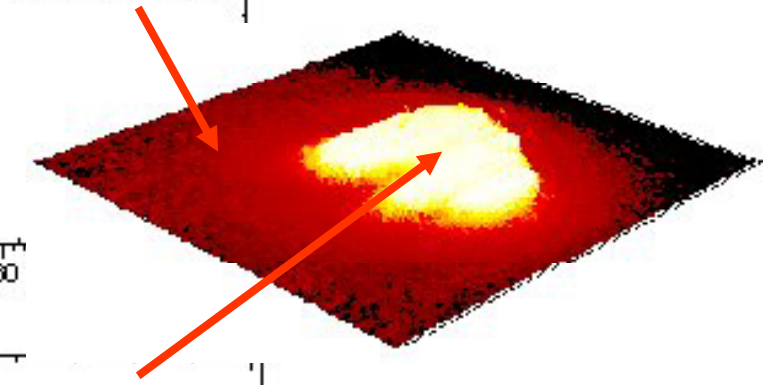
TOF-SIMS

Pin-hole in a paint layer







Distribution of fluorine

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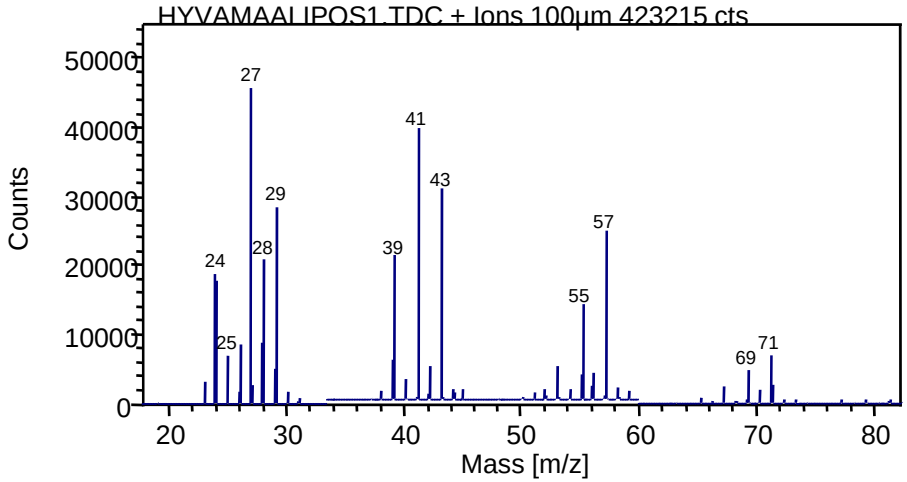
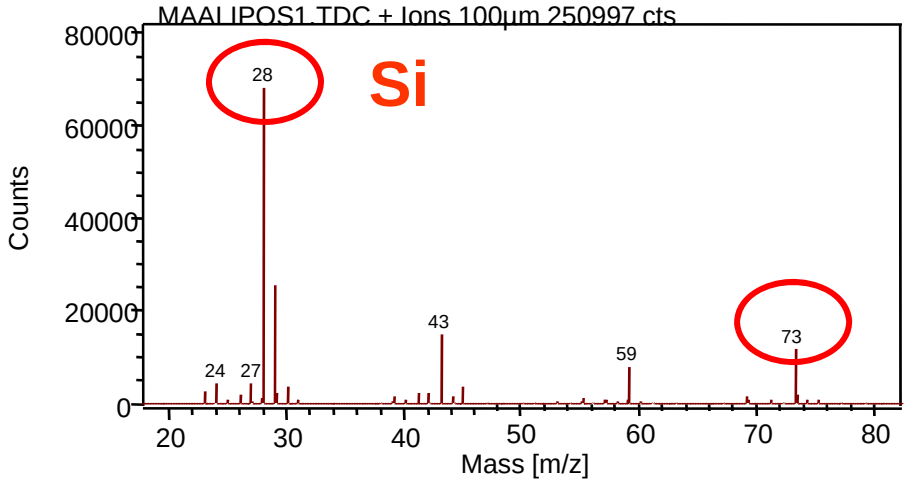
TOF-SIMS

Good and poor paint adhesion



Spectrum measured at substrate-paint interphase

good adhesion



poor adhesion

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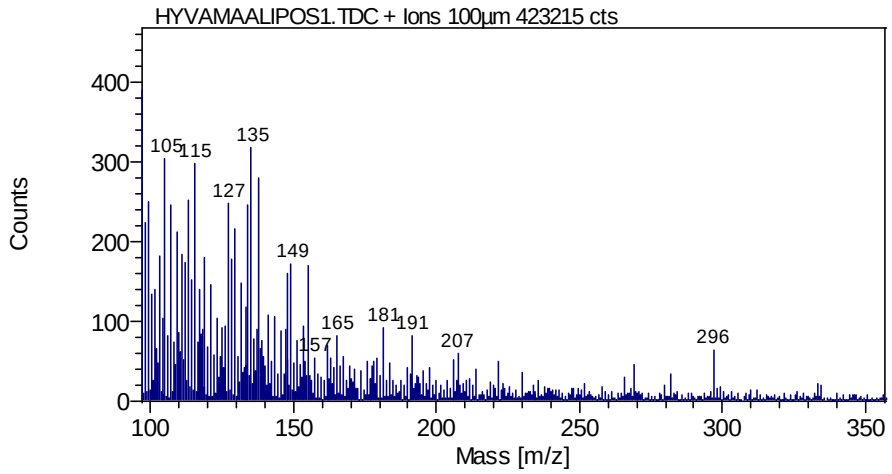
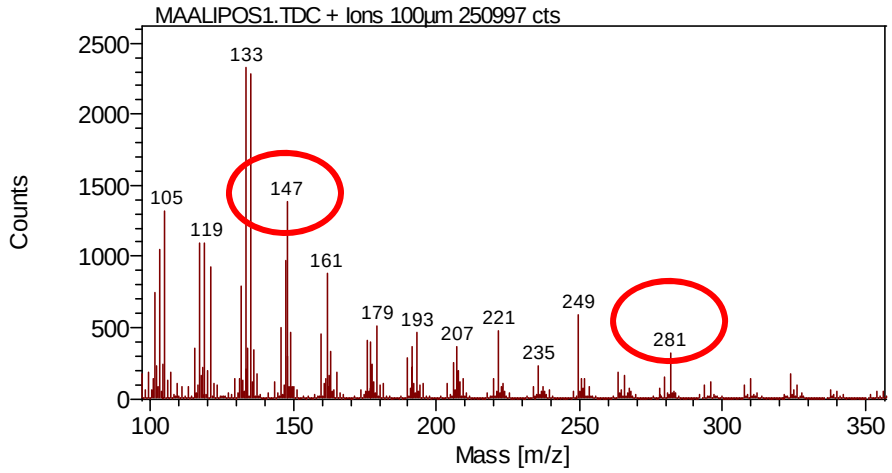
TOF-SIMS

Good and poor paint adhesion



Good adhesion



Poor adhesion due to PDMS contamination

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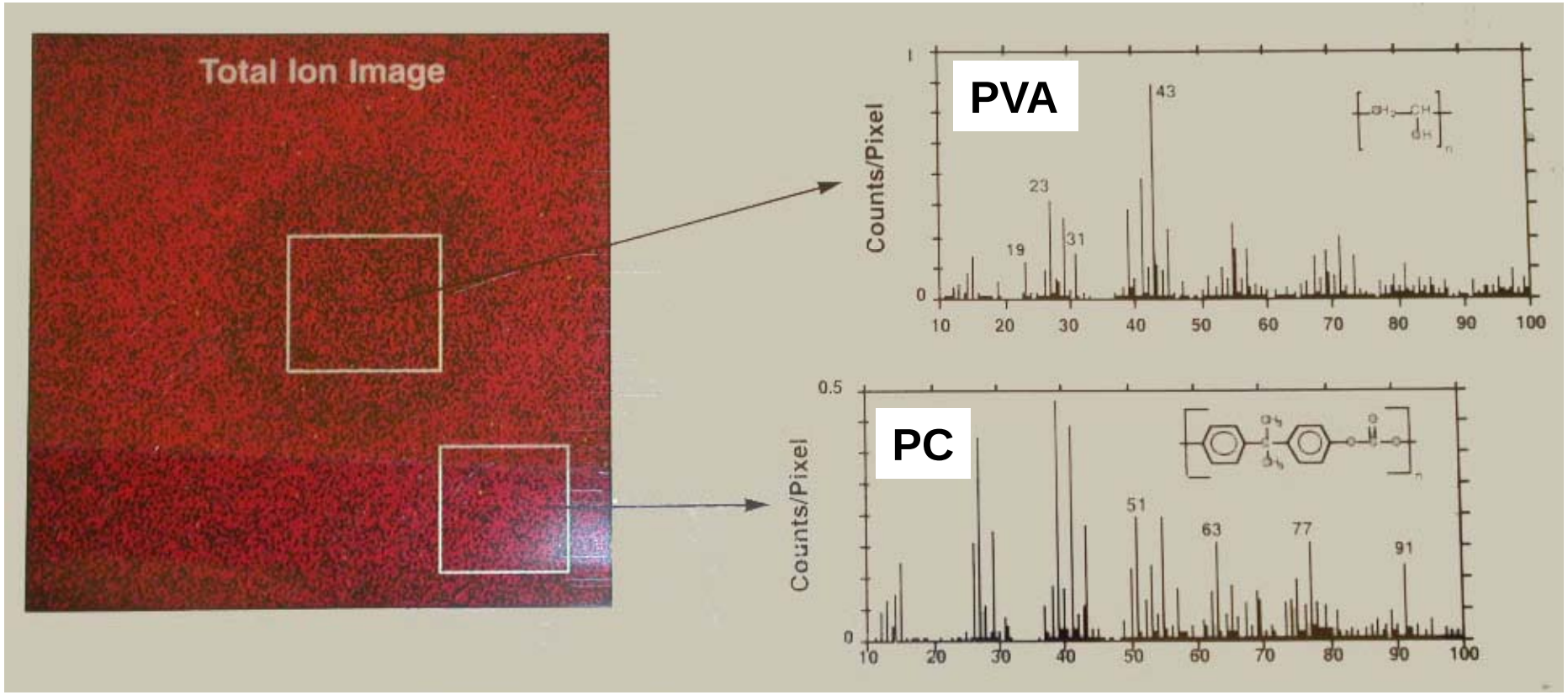
TOF-SIMS

Identification of contamination on polycarbonate surface



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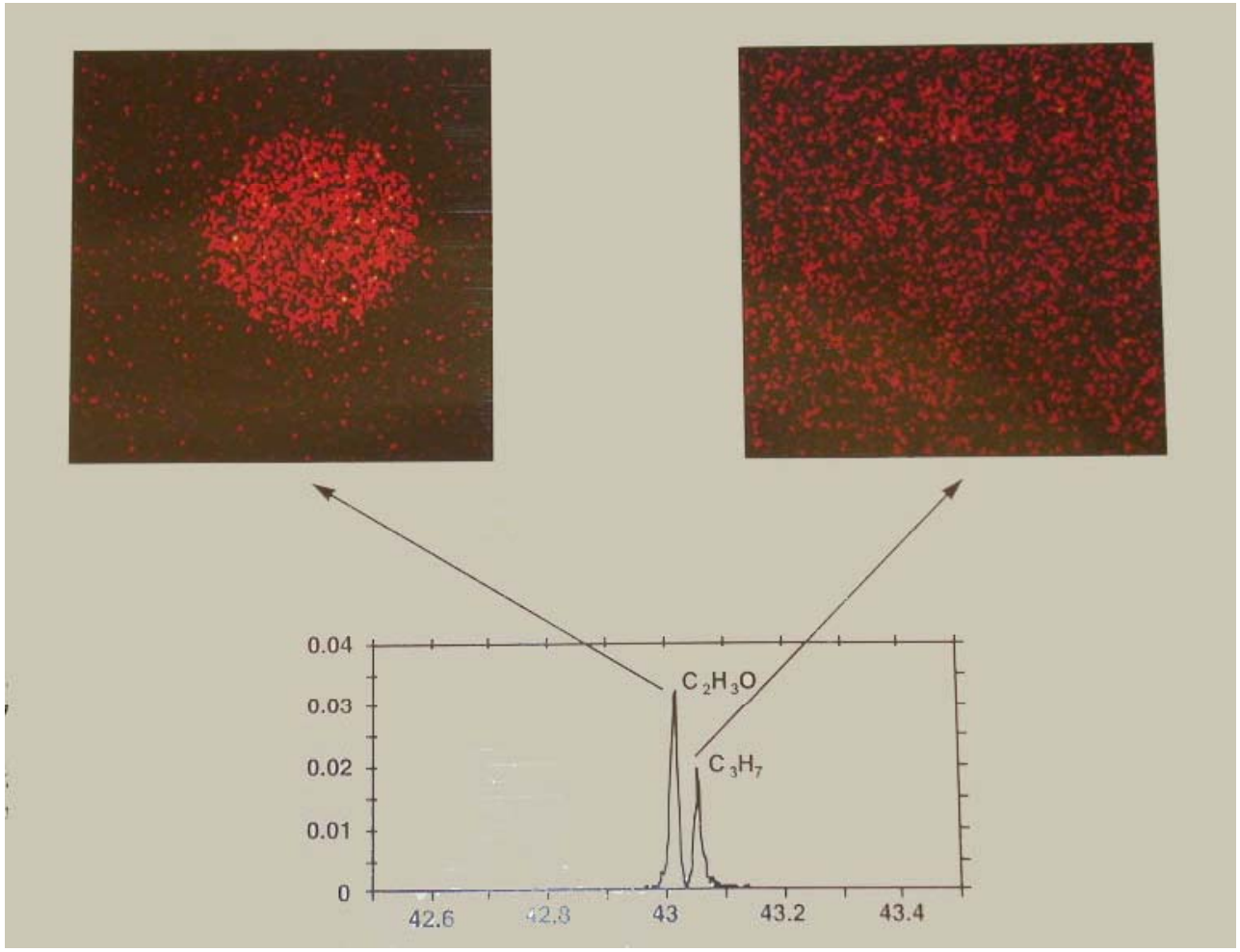
TOF-SIMS

Identification of contamination on polycarbonate surface



High mass resolution and surface sensitivity allows selective identification of organic compounds on an organic substrate

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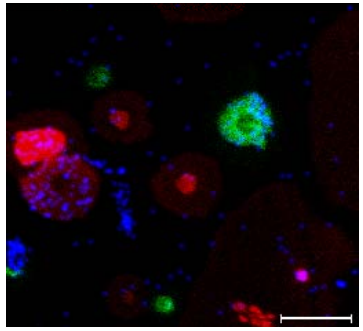
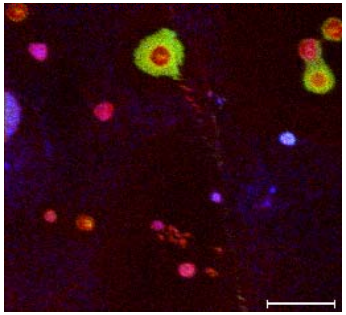
ToF-SIMS in particle analyses

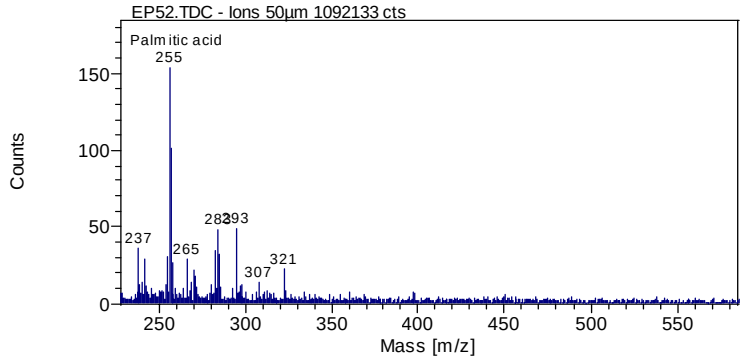


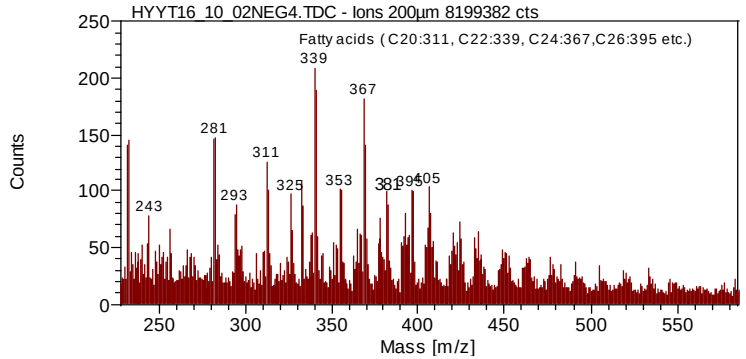


Positive ions:
Na=red,
Ca=Green NH_4=blue

Negative ions:
O=red,
NO_3=green,
SO_3=blue

Aerosol particles collected on an In foil.
TOF-SIMS-maps of selected ions





TOF-SIMS spectra of different aerosol particles showing the presence of different fatty acids on the particle surface.

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