SGS-GRUPPE
DEUTSCHLAND

**Services Analytical Tribology**

Dr. Olaf Günnewig • Dipl. Ing. Sven Felten

WHEN YOU NEED TO BE SURE

SGS

# DATA & FACTS

**Nº1**
**WORLD LEADER**

**80,000**
**EMPLOYEES**

**1,650**
**OFFICES AND LABORATORIES**

**13**
**GLOBAL INDUSTRIES**

**GLOBAL SERVICE LOCAL EXPERTISE**

# DATA & FACTS

## DATA & FACTS

### SGS SA

| | | | |
|---|---|---|---|
| **1878** Founded in Rouen (France)<br>**1915** New head-quarters in Geneva | **80,000** More than 80,000 employees worldwide | **1,650** Global net-work of over 1,650 offices and labora-tories | **5.8** Total revenue in 2013: CHF 5.8 billion<br>**5.9** Total revenue in 2014: CHF 5.9 billion |
|  |  |  |  |
| **1920** Since 1920 in Germany. Holding registered in Hamburg | **3,000** Over 3,000 employees all over Germany | **40** offices and laboratories in Germany | **283.85** Total revenue in 2014: EUR 283.85 million |

### SGS SOCIÉTÉ GÉNÉRALE DE SURVEILLANCE HOLDING (DEUTSCHLAND) GMBH

# DATA & FACTS

# ONE BRAND – ONE COMPANY

# POTENTIALLY INVOLVED LABS

## FDA Dortmund

- Failure- and damage analysis
- Prevention
- R&D-support
- Special analytics
- Surface analytics
- Development of new test and analysis methods

## OGC Speyer

- Standard fuel and oil analysis
- World wide fuel survey
- Market research
- Additive analytics (identification and quantification)

## OGC Schwechat

- Drive technology center
- Engine test benches
- Component test benches
- Exhaust gas test benches and exhaust gas analysis

# SGS DORTMUND - SERVICES & EXPERTISE

Accredited Nadcap™
Materials Testing Laboratory

DAkkS Deutsche Akkreditierungsstelle D-PL-14115-09-00
DIN EN ISO / IEC 17025

## OUR SERVICES

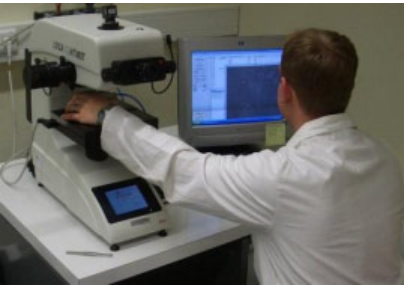
- Failure and damage analysis, expertises, patent expertises and survey reports
- Quality assurance and release testing
- R&D-Support
- Development of new test and analysis procedures

## OUR EXPERTISE

- A multidisciplinary team of highly trained experts from different fields like
  - Physics
  - Material Science
  - Electrical Engineering
  - Mechanical Engineering
  - Aerospace Engineering
  - Chemistry
  - Mineralogy

handles nearly 1,000 damage cases per year.

# SGS DORTMUND - ANALYTICAL METHODS



## OUR ANALYTICAL METHODS

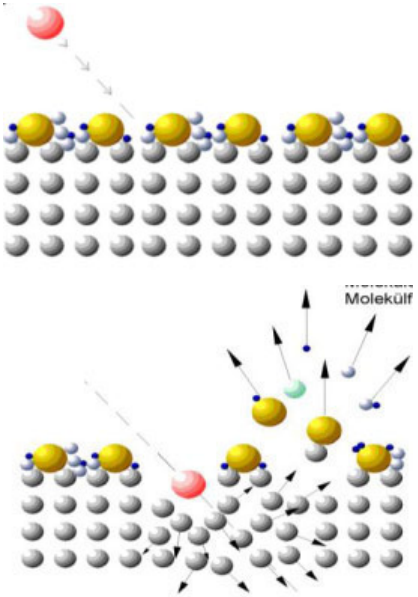
- Preparation, Metallography, Materialography
- Topography and Materials Diagnostics
  - Optical Microscopy and Digital Microscopy
  - Scanning Electron Microscopy (SEM / ESEM / HREM / EDX)
  - Focused Ion Beam (FIB)
  - Transmission Electron Microscopy (TEM)
  - Atomic Force Microscopy (AFM)
- **Surface Analysis**
  - **Time-of-Flight secondary ion mass spectroscopy (TOF-SIMS)**
  - **Secondary Ion Mass Spectroscopy (D-SIMS)**
  - **X-ray Excited Photoelectron Spectroscopy (XPS)**
  - **Auger Electron Spectroscopy (AES)**
  - **X-ray Diffractometry (XRD)**
- Non-destructive Testing (NDT)
  - Digital Radioscopy
  - 3D-Computerized Tomography (incl. Reverse Engineering)
  - Ultrasonic Testing and Scanning Acoustic Microscopy (SAM)

# SGS DORTMUND - ANALYTICAL METHODS

## OUR ANALYTICAL METHODS

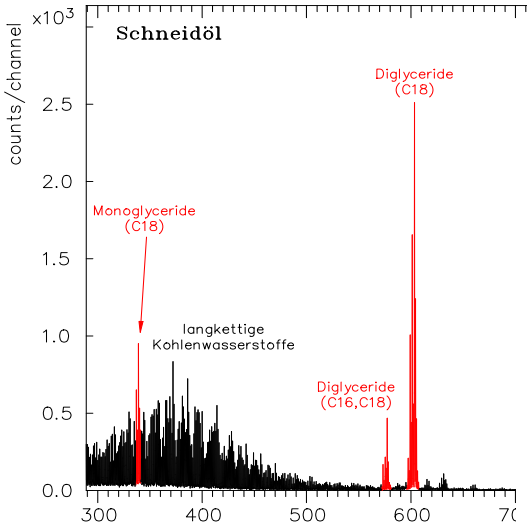
- Chemical Analysis
  - Chemical Material Analysis (ICP-OES, ICP-MS)
  - Gas Chromatography (GC) with different detection (e.g. MS)
  - High-Performance Liquid Chromatography (HP-LC)
  - Ion Chromatography (IC)
- Polymer Analysis
  - Infrared Spectroscopy (FT-IR/ATR FT-IR/IR Mikroskopie)
  - Thermal Analysis (TGA)
  - Differential Scanning Calorimetry (DSC)
  - Dynamic Mechanical Analysis (DMA)
  - Gel Permeation Chromatography (GPC)
- Electronics Lab
  - Network Analysis, Time Resolved Signal Analysis (5GS), Curve Tracing
  - Microohm Measurements (Dry Circuit), LCR Measurements
  - Semiconductor Test (Spreading Resistance-Profiling (SRP), OBIRCH)
- Mechanical – Technological Testing
  - Tensile and Bending Test / Notch Impact Test
  - Micro- and Macrohardness

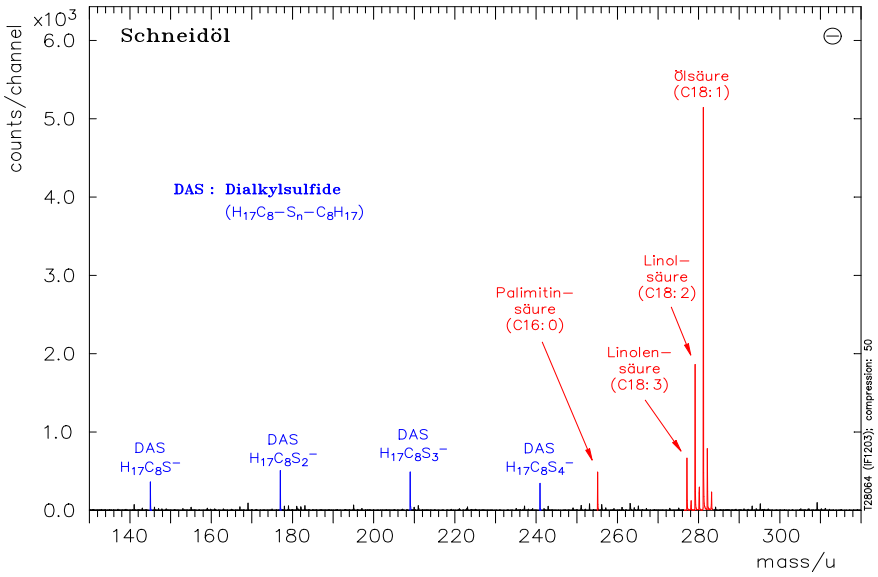
# SGS DORTMUND - EXAMPLES




## TOF-SIMS CHARACTERISATION OF DRAWING OILS

- Characterization of fatty acid pattern and additivation



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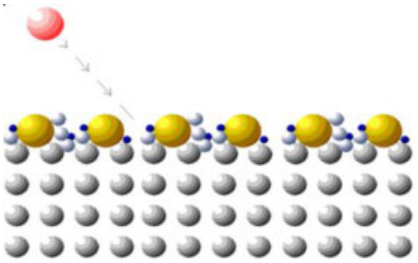
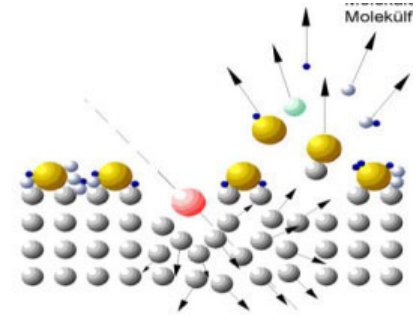
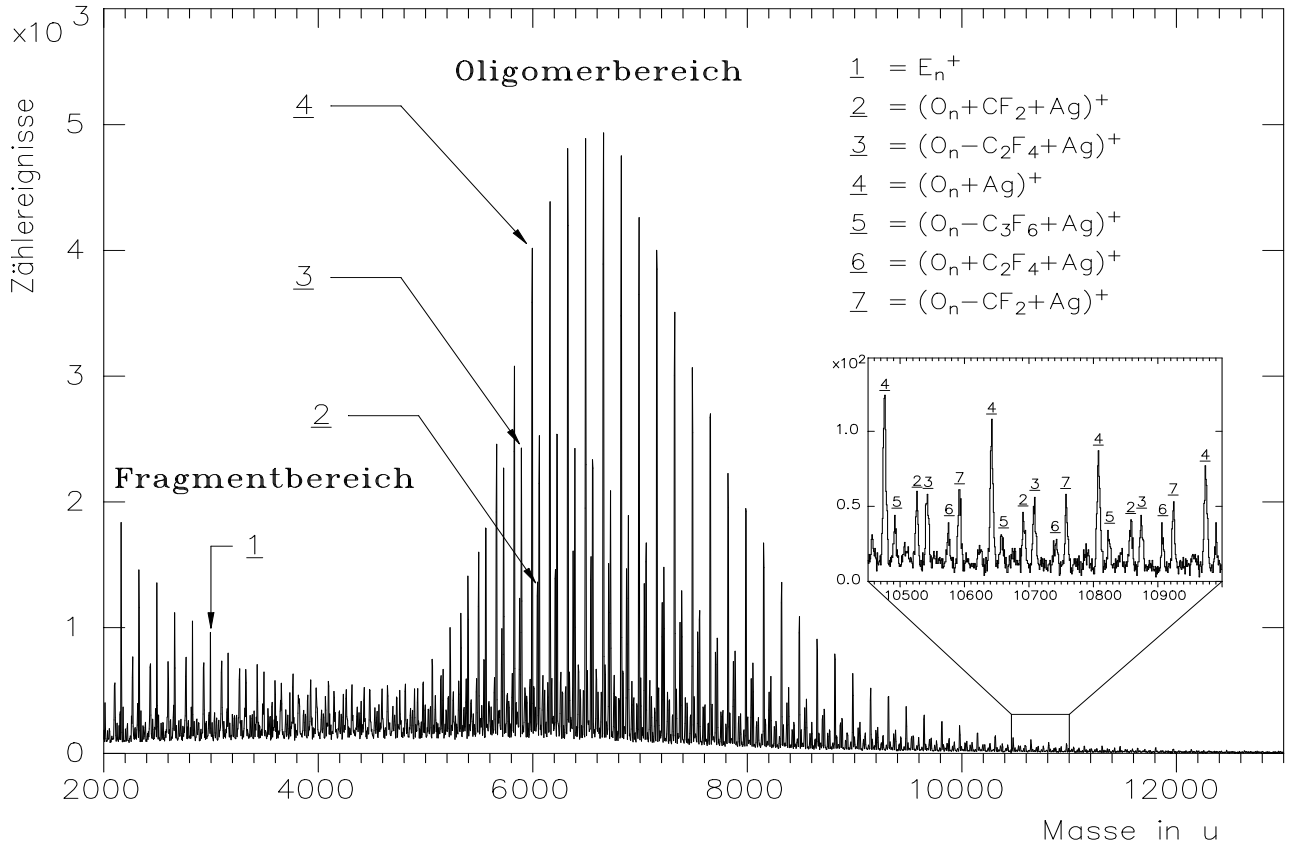





## TOF-SIMS MOLECULAR WEIGHT DISTRIBUTION

- Molecular weight distribution of PTFE (Krytox 47)



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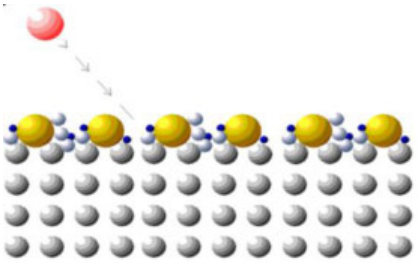
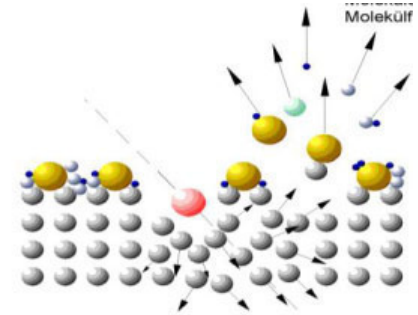
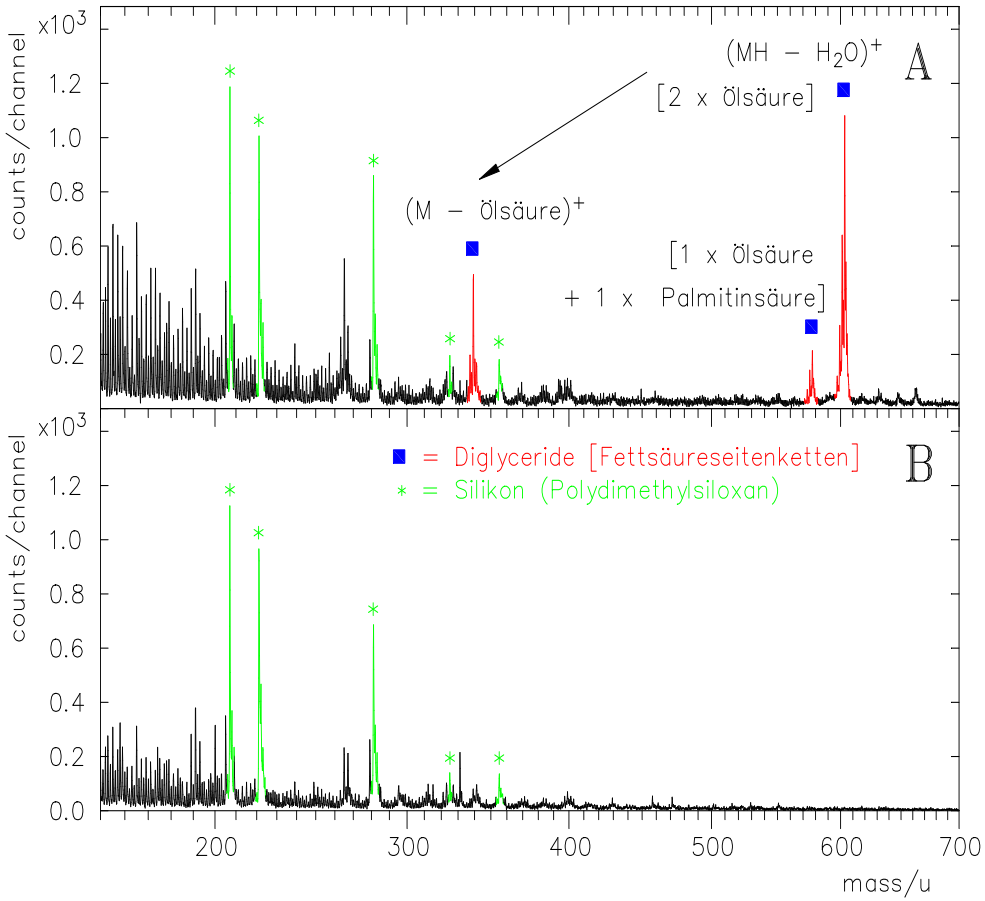





## STEAM DEGREASING OF AN ALUMINUM SURFACE

- The aluminum surface was investigated before and after the cleaning process by TOF-SIMS.
- Silicone deposits could not be removed from the aluminium surface by the steam degrea-sing cleaning process (as seen in the green peak pattern).



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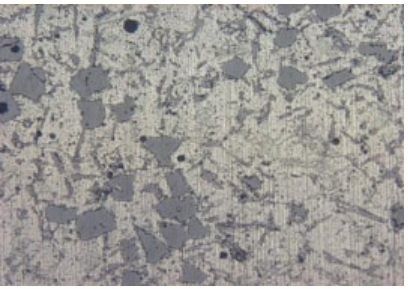
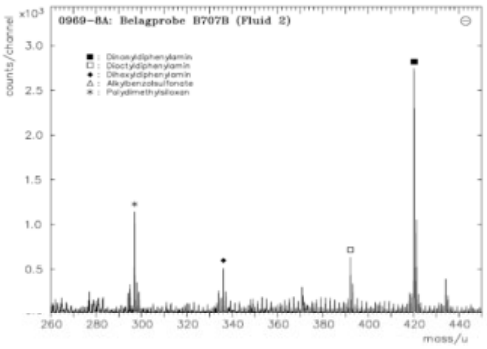
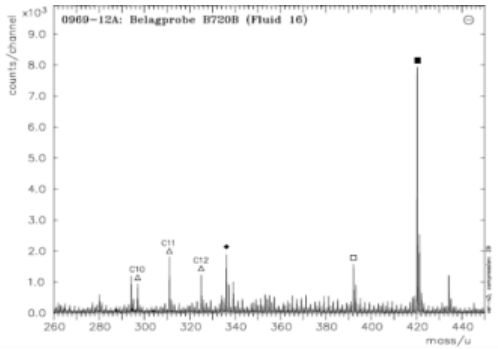
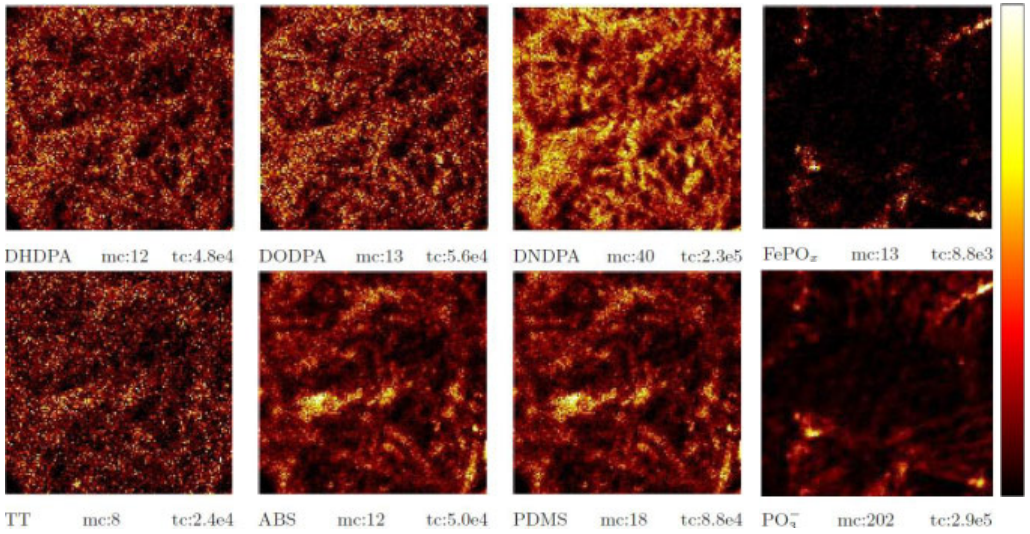


## ANALYSIS OF OIL ADDITIVE DISTRIBUTION ON SURFACES

- Antioxidants
  - DHDPA
  - DODPA
  - DNDPA
- Corrosion protection
  - TT
  - ABS
- Defoamer / Grease
  - PDMS

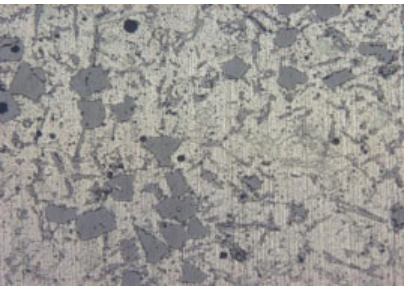


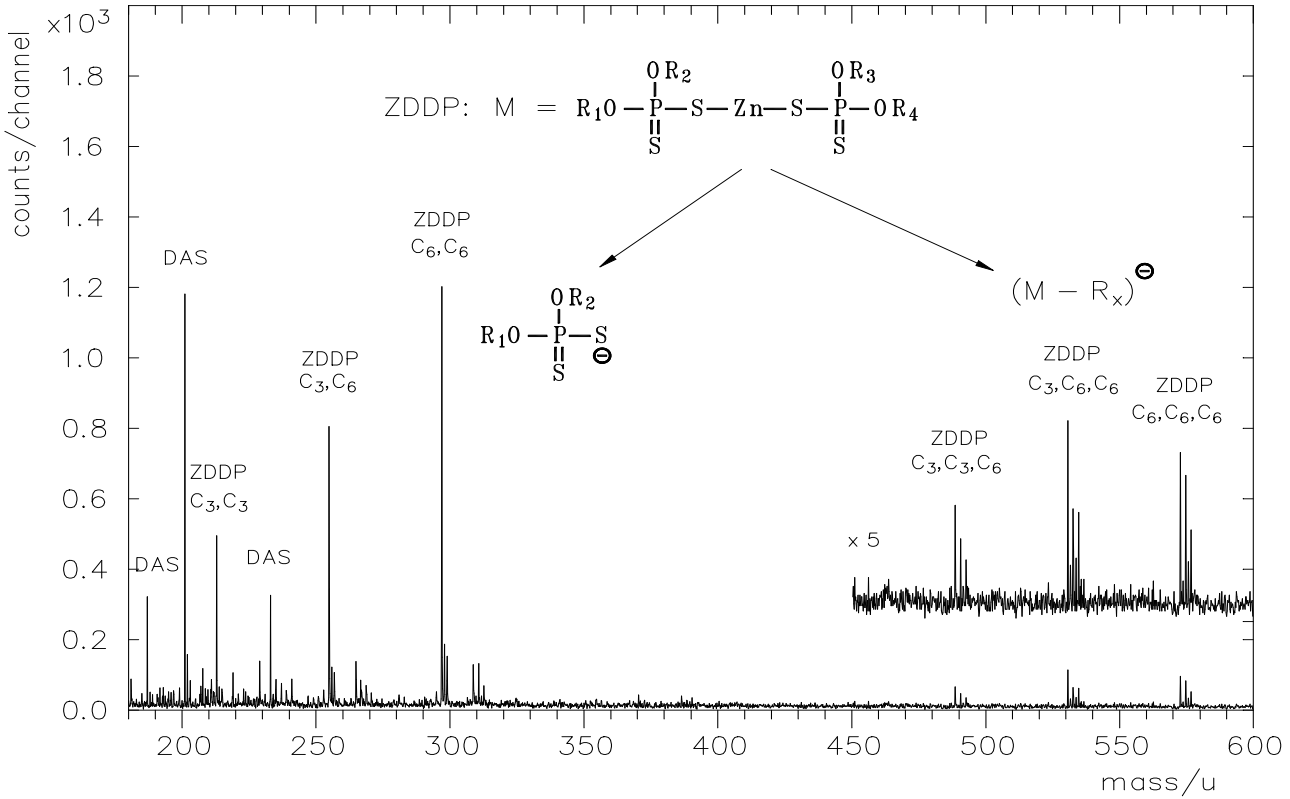

| Abk. | Verbindung | Masse |
|---|---|---|
| MA | Verb. auf Basis Methacrylsäure/Methacrylat | -85 u |
| DHDPA | Dihexyldiphenylamin | -336 u |
| DODPA | Dioctyldiphenylamin | -392 u |
| DNDPA | Dinonyldiphenylamin | -420 u |
| TT | Tolyltriazol | -132 u |
| PDMS | Polydimethylsiloxan | -223 u |
| FePOx | Eisenphosphate | -215 u |
| ABS | Alkylbenzolsulfonate | -183 u |

# SGS DORTMUND - EXAMPLES



## SURFACE ANALYSIS ON CYLINDER / PISTON SURFACES

- Surface investigations were carried out by SEM and TOF-SIMS



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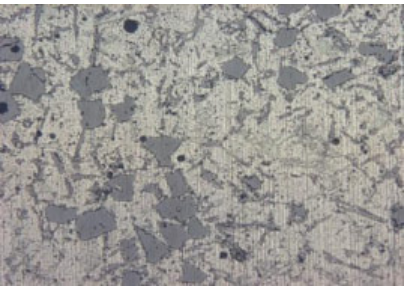

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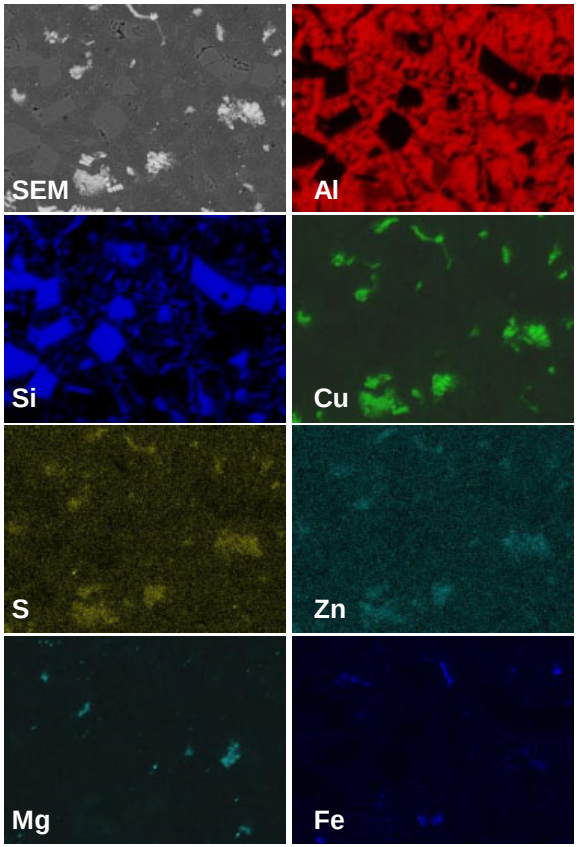
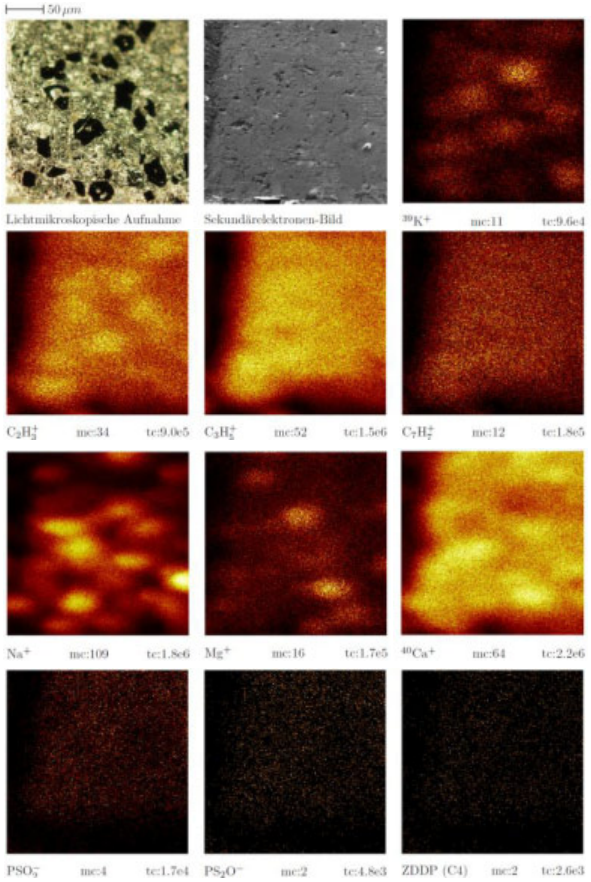
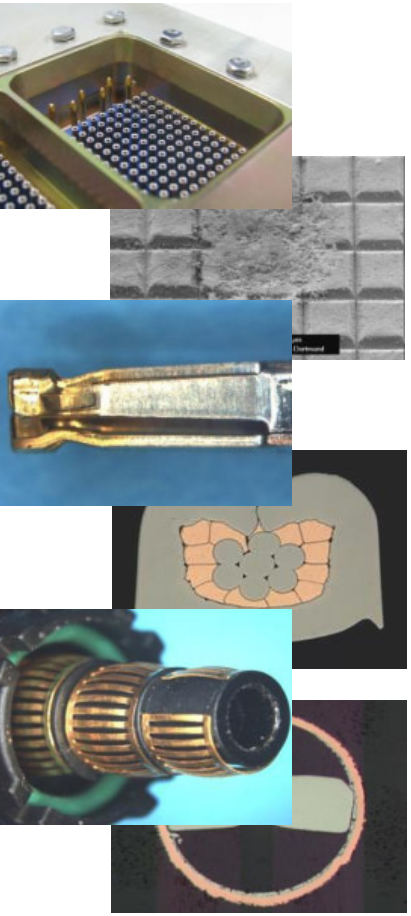



SEM
element map



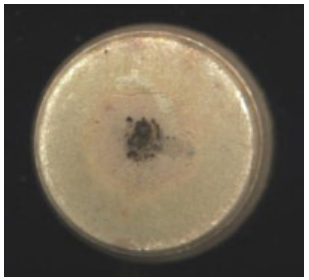

TOF-SIMS
chemical map

# SGS DORTMUND - EXAMPLES



## ELECTRICAL CONTACTS AND CONNECTORS

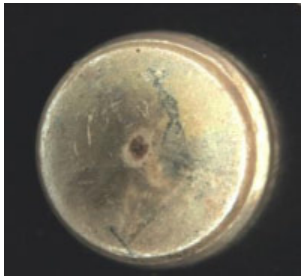
- Lubrication of electrical contacts to avoid electrical resistance increase
  - A lubricant system was chosen and qualified to avoid silicone contamination



**With lubrication**

→ **No silicon and oxygen signals on contact**

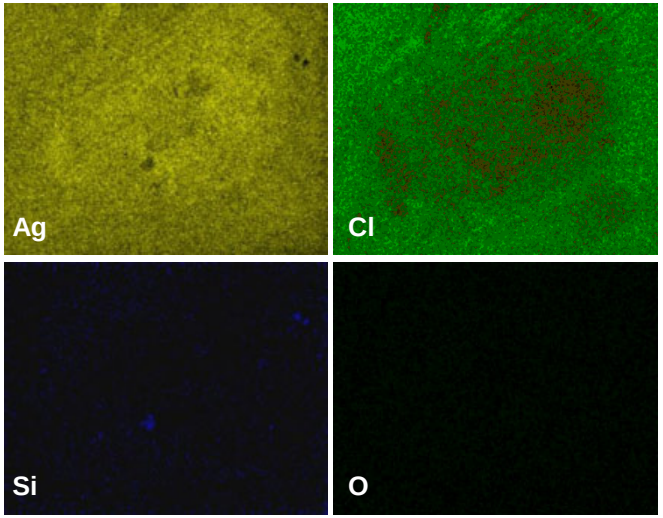
→ **No silicone formation**

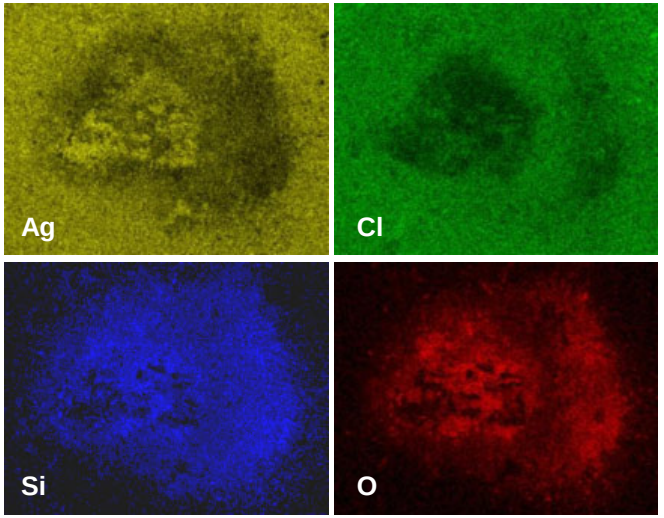


**Without lubrication**

→ **Strong signals of silicon and Oxygen on contact**

→ **Silicone formation**



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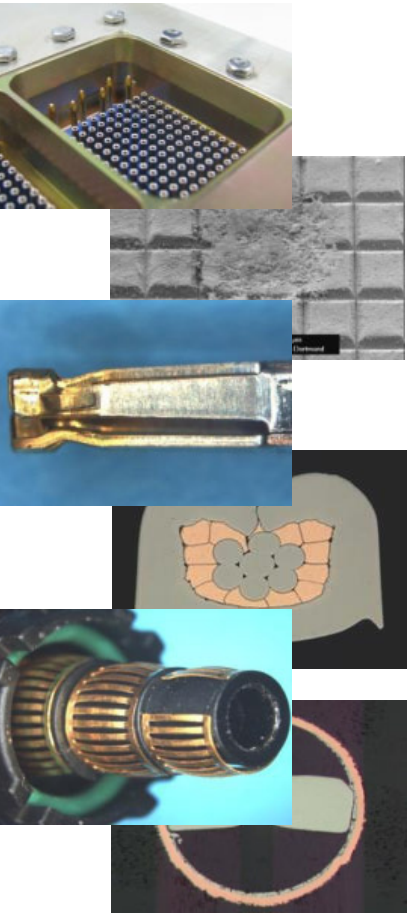
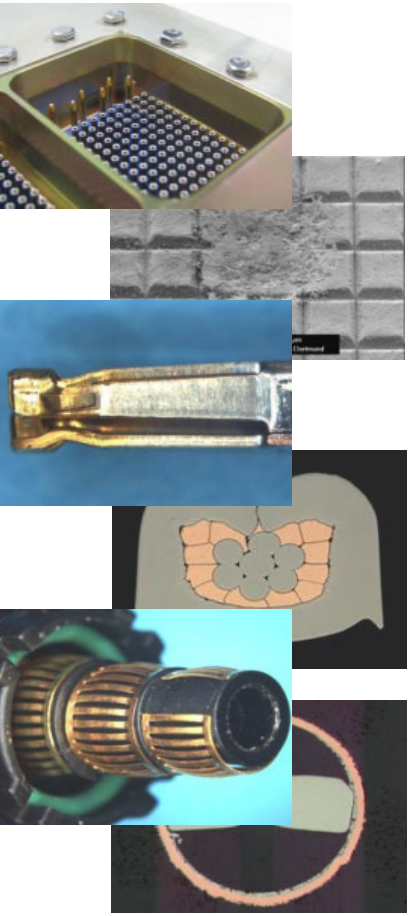


## ELECTRICAL CONTACTS AND CONNECTORS

- Analysis on different coatings on Ag contact surfaces

| Alkane Thioles | Chromate Coating | Palladium |
|---|---|---|
| • Organic Coating X-(CH2)n-SH, n=18<br>• Immersion process, realisation of monolayers or reservoirs possible<br>• Self-healing of coating after mechanical abrasion<br>• Transparent, no resinification<br>• Reduction of insertion and drawing forces<br>• Negative impacts on bonding and gluing capability<br>• Detection of configuration: TOF-SIMS | • Anorganic Coating<br>• Electrodeposition of coating thicknesses in nm-range<br>• Coating mechanically not resistant; only temporarily protection<br>• Transparent or yellow color<br>• Negative impact on electrical contact resistance at lower voltages<br>• Detection of configuration: AES or XPS<br>• Thickness: AES, TEM | • Metal Coating<br>• Electrodeposition of coating thicknesses in the range of 20-30 nm<br>• Coating mechanically not resistant; protective effect under storage cond. >7 month<br>• Good adhesion during mould processing, gluing and solde-ring possible<br>• Bonding poss. (Al - thick wire)<br>• Detection of configuration: AES or XPS<br>• Thickness: AES, TEM |

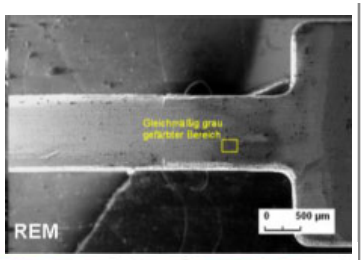
# SGS DORTMUND - EXAMPLES

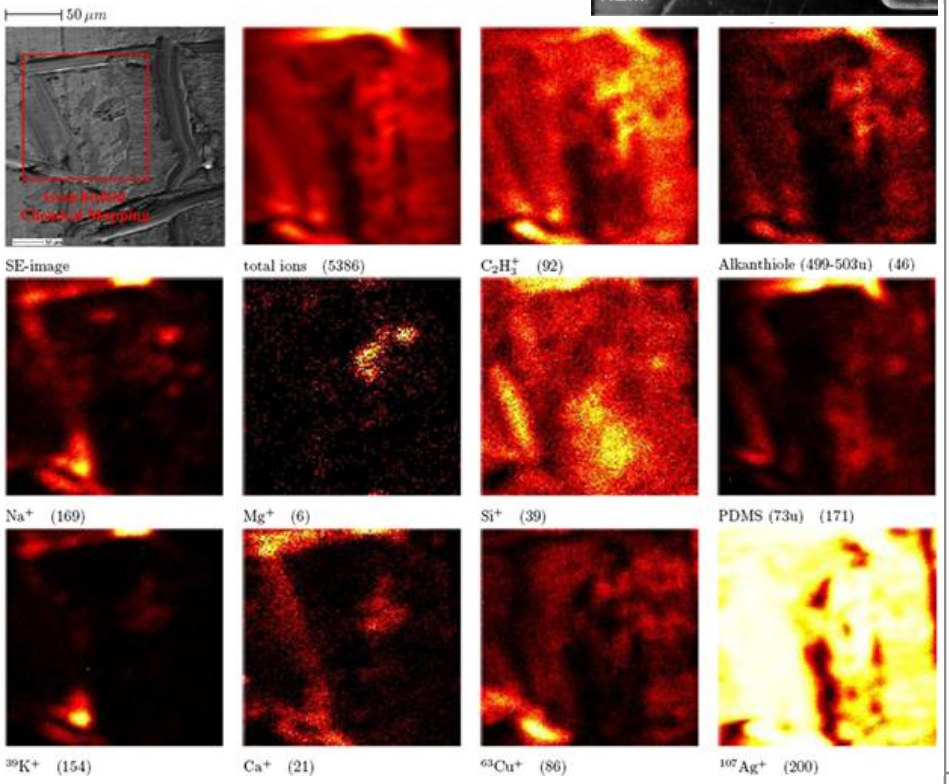


## ELECTRICAL CONTACTS AND CONNECTORS

- Alkane thiole passivation of Ag contact surfaces

| Substanz | Präparate 05 01A | Präparate 05 01B |
|---|---|---|
| Additive: | | |
| Alkanthiol (1–Octadecanthiol) | ■ | ■ |
| Alkansulfonat (C18) | ■ | ■ |
| Alkali–/Erdalkalimetalle u. Verb. | | |
| Calcium | ▪ | ▪ |
| Kalium | ▪ | ▪ |
| Magnesium | □ | ▪ |
| Natrium | ▪ | ■ |
| Anionen (semispezifisch) | | |
| $CN^-$ | ▪ | ▪ |
| $NO_x^-$ | □ | □ |
| $PO_x^-$ | □ | □ |
| $SO_x^-$ | ■ | ■ |
| Fettsäuren (FS): | | |
| höhere Fettsäuren ($\geq$ C13 = Tridecansäure) | — | ■ |
| Fluorhaltige Verbindungen: | | |
| Fluorhaltige Verbindung (teflonartig) | — | □ |
| Halogene: | | |
| Chlor | ■ | ■ |
| Fluor | ▪ | ▪ |
| Iod | ■ | ■ |
| Brom | ▪ | ▪ |
| Metalle / Metallverbindungen: | | |
| Aluminium | □ | □ |
| Eisen | — | ▪ |
| Kupfer | ▪ | ▪ |
| Silber | ■ | ■ |
| Silberverbindungen | ■ | ■ |
| Zinn | ▪ | ▪ |
| Schwefel | ■ | ■ |
| Silicium | ■ | ■ |
| Silikone | | |
| Polydimethylsiloxan | ■ | ■ |



# SGS SPEYER - SERVICES & EXPERTISE

- 1450 m² Total Lab Space
- Currently 61 employees working in the field of fuel, lubricants, fuel additives and operating liquids testing

Some Key Customers…

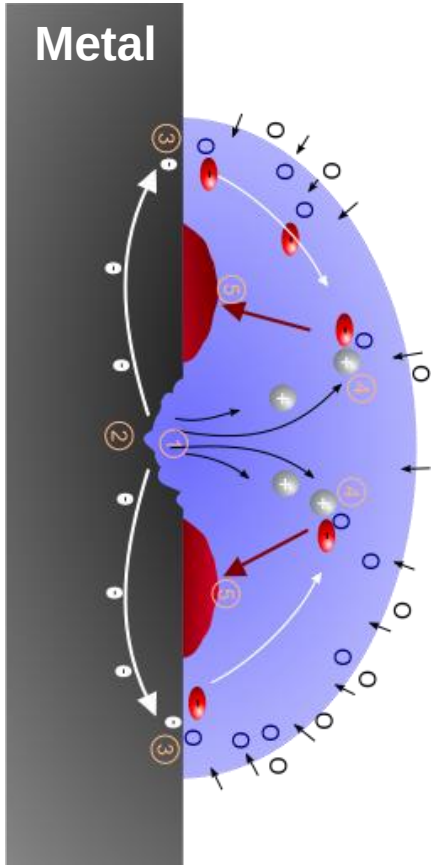
- Additive suppliers
- Global oil companies
- Global automotive OEMs
- Up-/downstream service providers

# SGS SPEYER - WORLD WIDE FUEL SURVEY

- Fuel Quality Monitoring over 25 years
  - Worldwide gasoline and diesel studies
  - Covering 145 countries
  - Analysis of key parameter and also special items
  - Monitoring of specification compliance per country
- Special services
  - Fuel and Market Studies
- Country specific surveys and evaluations
  - Africa, Brazil, China, India, Indonesia, Russia, Thailand, USA

# SGS LUBRICANT INDUCED METAL CORROSION

Electrochemical impedance spectroscopy




**Lubricant**

- Scrutiny
  - Metal corrodes in contact with lube
  - Metal forming coatings
  - Metal corrodes / corrosion pittings
  - Lube changes color / odour
- Analysis
  - Corrosion tendency of metal surface *($R_{ct}$) – Charge Transfer*
  - Electrochemical surface roughness *($C_{dl}$) – Double Layer Capacity*
  - Overall conductivity / corrosion tendency *($R_s$) – Electrolyte Resistance*

# SGS LUBRICANT INDUCED METAL CORROSION

Frequently asked questions

- Corrosion of workpieces in contact with lubricants
  - Your lubricant meets all specification requirements including corrosion but somehow only slight variation of e.g. temperature shows a complete different picture
    - Is there some kind of activation mechanism which suddenly will change corrosiveness of lube oil formulations?
  - Fresh oil passes all tests but used oil after a short period of operation fails
    - Do used oils really have different corrosiveness? Is there a way to quantify/compare corrosion tendencies precisely?
  - All lubricant properties of concern are tested and pass but long term field tests constantly fail
    - Are there cooperative effects between work piece material and lubricant affecting fail?

# SGS OIL CONDITION MONITORING

**Diagnosis**


**Labservice**

**Industrial**

**Transport**

# CONTACT

**CONTACT TO US**

**MANY THANKS FOR YOUR ATTENTION!**

SGS IS THE WORLD'S LEADING INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY.


Dr. Olaf Günnewig
Standortleiter

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