Technical specifications:
- Electron Optics and SEM Electronics: Zeiss 1430 XVP
  Resolution in HV mode is 10 nm
- Variable Pressure (VP) mode up to 3000 Pa
- Detectors: Everhart-Thornley detector for HV-SE
- Channeltron for HV-SE
- 4-quadrant BE Detector for HV and VP
- EDX system Bruker 630-X-Flash detector SC MAPM
- EBSD system HKL with NordYX – camera
- In-situ: Three- and four-point bending experiment with heating possibility
  1500°C heating module
  Scratch Test
  Optical Laser Setup

Advantages:
- Non-destructive examination of large objects with scanning electron microscopy (SEM) and microanalysis (EDX).
- This results in the possibility of cyclic examination of components after different operating phases.
- In situ tests with dedicated test equipment are possible.
- Variable pressure function for investigation of low or non-conductive samples.

Challenges:
- Peripherals that were not designed for vacuum in conventional scanning electron microscopy had to be adapted for use in vacuum and pose risks. For example, detector electronics, cooling water hoses, etc.
- The size, construction and weight of the system require an appropriately sized damping system. Nevertheless, the chamber is susceptible to vibrations, transmitted by pumps, passing vehicles, steps, etc., among other things.

Application example:
Due to a high number of injectors and a length of up to 25 cm per sample, an investigation using the large-chamber scanning electron microscope is expedient. A special holder was manufactured for this purpose, which can accommodate a large number of injectors.

For this purpose, SE and BSE images of the injection openings of the injectors were taken and EDX analysis of the deposits around the openings were performed.

Injection nozzles (injectors) in the automotive industry are highly stressed components. They are very prone to heavy soiling. These nozzles are never identical in construction. Therefore, it is not enough to simply replace them, as new injectors require adjustments to be made to the engine control unit. Targeted cleaning can help, since cleaning an injector is more cost-effective than installing a new injector, preventing the need for readjustments.

In this case, a cleaning process was carried out by an institute of the RWTH Aachen University and the injectors were made available to us for examination purposes before and after this cleaning procedure in order to evaluate the effectiveness of the cleaning electron-optically and analytically.

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InSitu bending experiment:
Characteristics:
The load is applied via a body which presses perpendicularly on the ends of the specimen via two points on the outside in each case. Bending is performed via a bending arm with either one (3-point bending) or two (4-point bending) contact points.
Bending tests are possible up to a force of 5000 N with simultaneous heating of the specimen up to 800°C.
Bending tests are possible on metal, ceramics, glass, plastics, ceramic or galvanic coatings, soldered and welded joints, minerals, wood and organic materials.
Both static and cyclic loading are possible.
Possible observations:
- Observations of surface changes under static and dynamic bending load
- Crack growth
- Delamination phenomena
- Formation of slip planes

Technical specifications:
- Maximum Force: 5000 N
- Maximum Movement: 17 mm
- Bending speed: 0.1 to 1000 μm/s
- Specimen dimensions: 50x50x2.5 mm (L×W×H)
- Temperature range up to 800°C

Summary:
The large-chamber scanning electron microscope is an excellent tool if the sample size exceeds the dimensions of conventional electron microscopes and the samples should not be destroyed.
Non-conductive materials or materials that outgas in a vacuum can also be examined.
Non-destructive testing offers the great advantage of being able to examine even rare or expensive components and materials by electron microscopy, and the large volume of the chamber offers the possibility of viewing more complex processes in-situ under an electron beam.

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References: