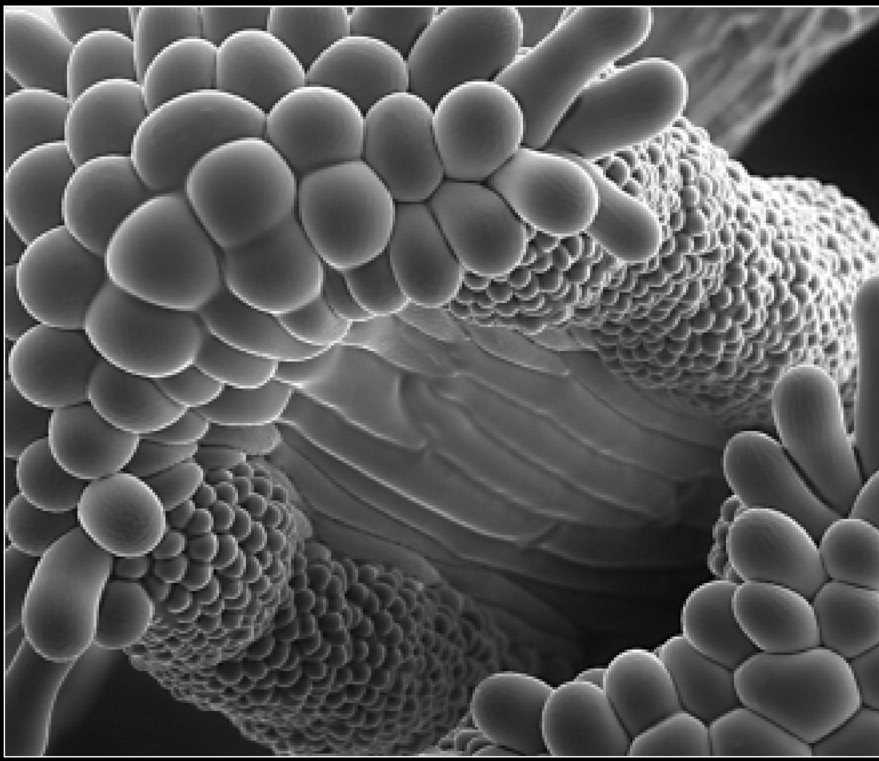
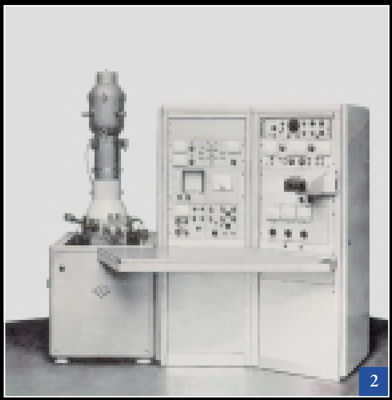
Britain-based Cambridge Instruments introduced the first commercial scanning electron microscope (SEM) – Stereoscan Mark I – in 1965. Today, the SEM is considered to be the ultimate nanotechnology tool.

During the past 40 years, the SEM has become an indispensable tool in multiple disciplines. From its early home in materials sciences, the SEM has entrenched itself in electronics, forensics, the paper industry and archeology. It is also used in pharmaceutical research laboratories, food technology and biology for the specific requirements to which it has been modified. Last but not least, the semiconductor industry also makes extensive use of the SEM in process control and failure analysis.



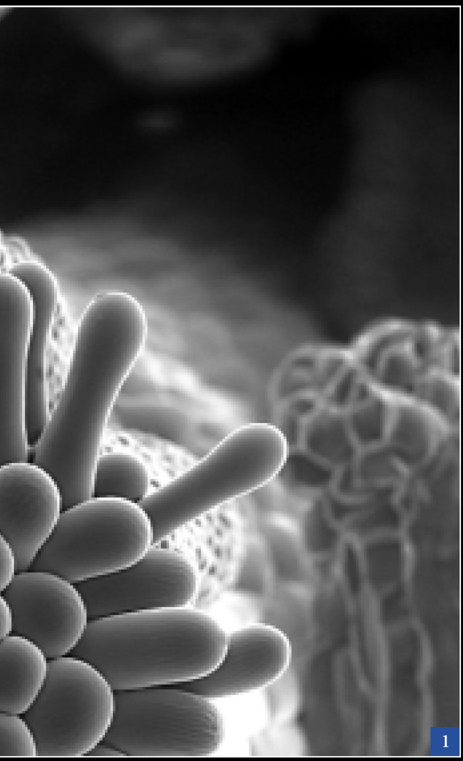
Insights into the Nano World: 40 Years of



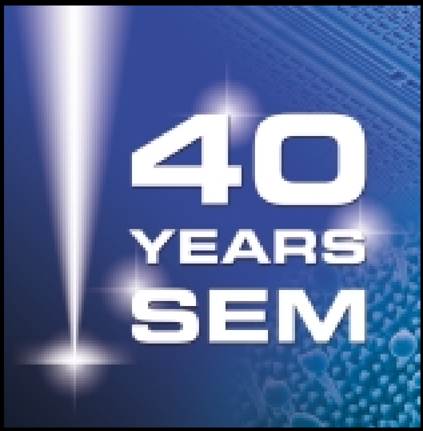
2

3

4



1



Scanning Electron Microscopy

Ongoing development

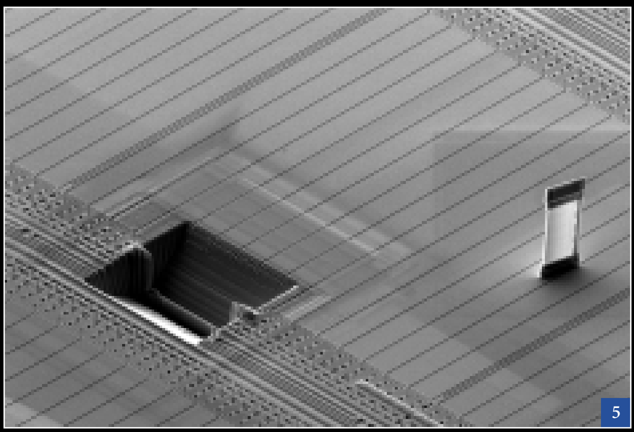
Ongoing development has resulted in entirely new functions since the first scanning electron microscopes were introduced. Two of these new developments are exceptionally important: the development of the ZEISS GEMINI® column in 1992, giving a boost to resolution, and the combination of the SEM column with a focused ion beam (FIB) column, transforming the instrument into a multi-versatile analysis system. This new system, CrossBeam®, provides entirely new insights into the area below the surface of a specimen. The benefit of CrossBeam® technology is the time-saving in-situ observation of material removal by ion etching or milling and polishing. The EVO® generation provides the widest range of SEMs for analysis. The newly developed backscatter electron detector further enhances the SEM's analytical capabilities. The emerging combination of Raman spectroscopy and SEM navigation is accommodated by an application-oriented microscope – the EVO® 50Raman.

Fig. 1:
Scar, part of the pistil, dahlia.

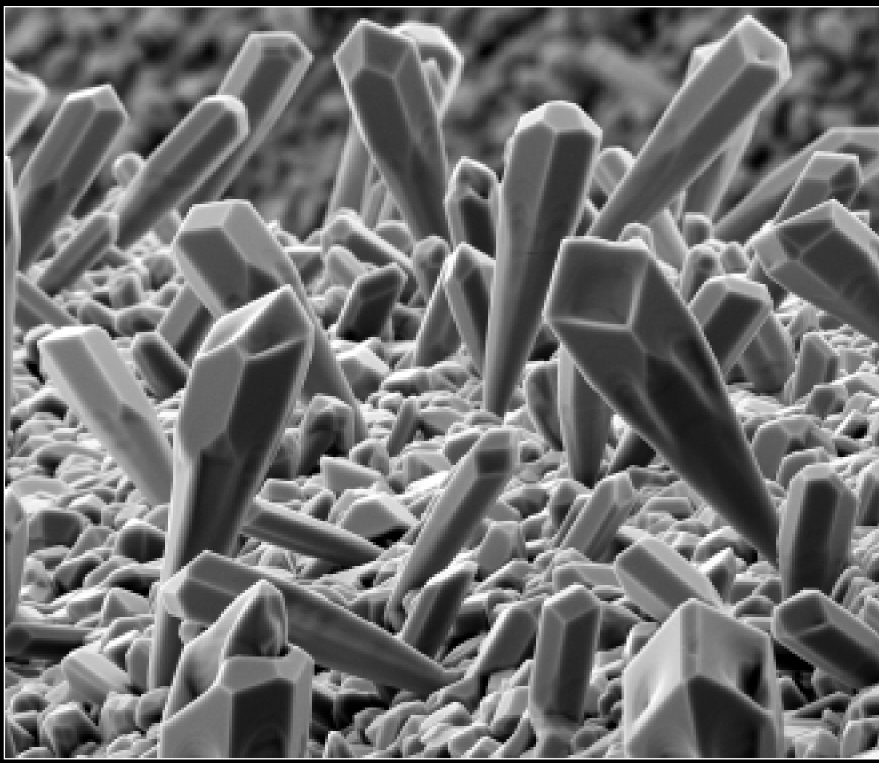
Fig. 2:
Stereoscan I (1965)

Fig. 3:
DSM 950 (1985)

Fig. 4:
EVO® 50 (2005)



5



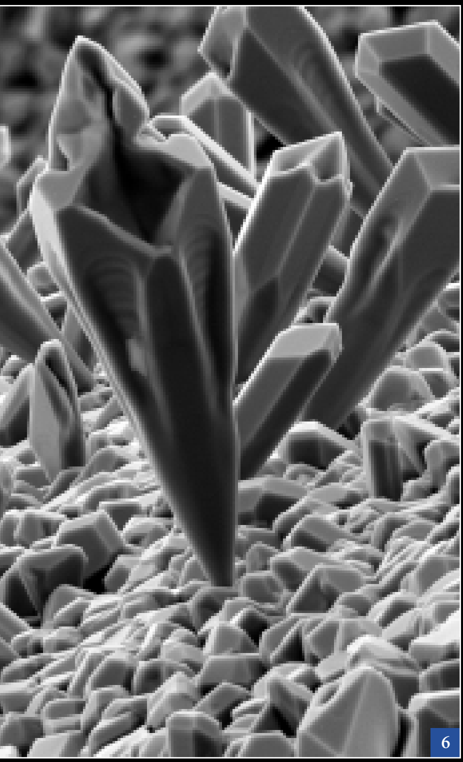
Variable pressure

Modern SEM systems can be operated both in the traditional high-vacuum mode and the VP (variable pressure) mode. In the VP mode, a small amount of gas – up to approx. 400 Pa – is introduced into the chamber and compensates for the charge accumulating on the surface of non-conductive specimens in a high vacuum. This allows naturally insulating materials such as paper and plastic to be analyzed without requiring a surface coating. By eliminating this need, time-consuming specimen preparation is greatly reduced, the overall operation of the microscope is simplified, the range of application areas where the SEM can play a role is widened and specimen throughput is increased. This increased flexibility is one of the key reasons behind the SEM's adoption for the examination of ceramics, plastics, forensic specimens and art objects.

Water vapor

A direct descendant of the first five microscopes produced in Cambridge is the recently introduced new generation of ZEISS EVO® XVP/EP REMs. Their new design allows the use of much higher chamber pressures and even permits the introduction of water vapor.

Its eXtended Variable Pressure (XVP) and Extended Pressure (EP) modes operate at up to 750 Pa and



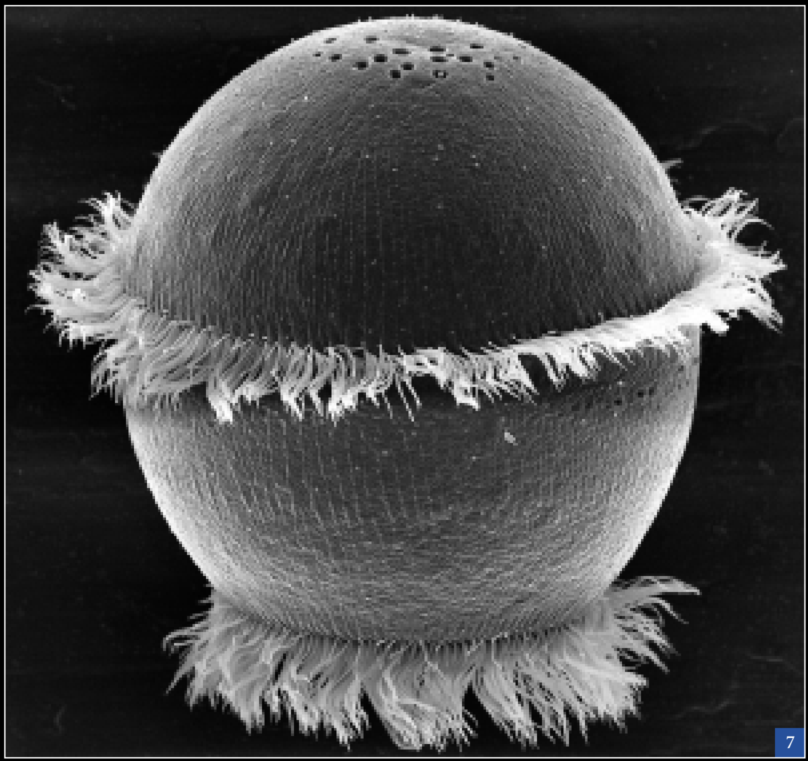


Fig. 5:
TEM lamella,
taken from pit.

Fig. 6:
Tungsten crystals

Fig. 7:
Ciliate

Fig. 8:
Fracture in weld seams of concrete steel: dimpled fracture with manganese oxide forming a honeycomb structure.

3000 Pa, respectively, and open up a new realm of research in life science, healthcare, food and pharmaceuticals, and also create a foothold in the new science of bioelectronics.

[*www.zeiss.de*]