Electron microscopy techniques for nano-particle analysis.

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In a Nature article, Vol. 323, dated 23rd of October 1986 it is announced that Ernst Ruska receives that years Nobel Price in Physics. His most important work began when he was a graduated student in late 20ties of last century and he worked on electron microscope ever since.

In those days the goal was to improve the performance of the microscope by developments focusing on resolution improvements on the one hand: on the other hand and surely not less important by improving and "finding" new preparation methods or techniques.

At the end of the last century computer technology, motorized stages, monitor and CCD cameras became essential parts of a modern electron microscope. Was in the old microscopes the alignment of microscope extremely important to achieve top quality results, in modern times the application part "how to prepare and handle the specimen became more and more important, not the microscope but the specimen determines the direction.

Innovation is still very important but nowadays the developments are done "with the voice of the customer". The development of the tools is not longer done in isolation at the manufacturer's site by physicists only. Many users from different discipline, e.g. nano biology, pharmacology are consulted before starting with a new application or a new design of a microscope. This resulted in specific developments to serve these markets, so are new techniques like electron microscopy and 3D-imaging extremely important for Life Science applications; ……and many more exciting developments will follow.

Nevertheless one should not forget that developments in other area's then electron microcopy contributed in an important way "how a modern microscope functions and looks like"! A well performing microscope is never the result of one or two parameters; it depends on the many variables working together.

The flat screen monitors, the computer control of the microscopes, the motorized stages, the CCD cameras to mention a few, changed in the last 10 years, a microscope session completely. Was the alignment of the microscope in the past an exercise of many hours, nowadays it is a matter of seconds since one restores the alignments of a computer file. In the past the recording of images was on film meaning that the images needed to be processed in the dark room and only were available 2 days after the microscope session. Nowadays one records the on a CCD camera (with very sensitive detectors for Direct Electron Detection) and the image appears instantly on one of the monitors.

All these developments make it possible to automate the microscope for specific applications like automated data collection, volume imaging, etc. Was, till about 10 years ago, an image from a TEM 2-dimensional and very difficult to interpret now one can collect a series of images automatically and represent them as a volume? A typical microscope session starts in the evening and continues during the night without the presents of an operator. The microscope or perhaps better the combination of hardware and dedicated software controls all the necessary functions of

the microscope; the computer program checks the movement and tilting of the stage, corrects the focus, corrects for image shifts etc. and collects a number of images during the night.

This approach reduces the time to result and instead of showing static results like one image, one is able to show dynamic images, movies or volumes from all directions making the interpretation of the result a lot easier. Examples will be showed of single article analysis using these modern microscopy techniques.