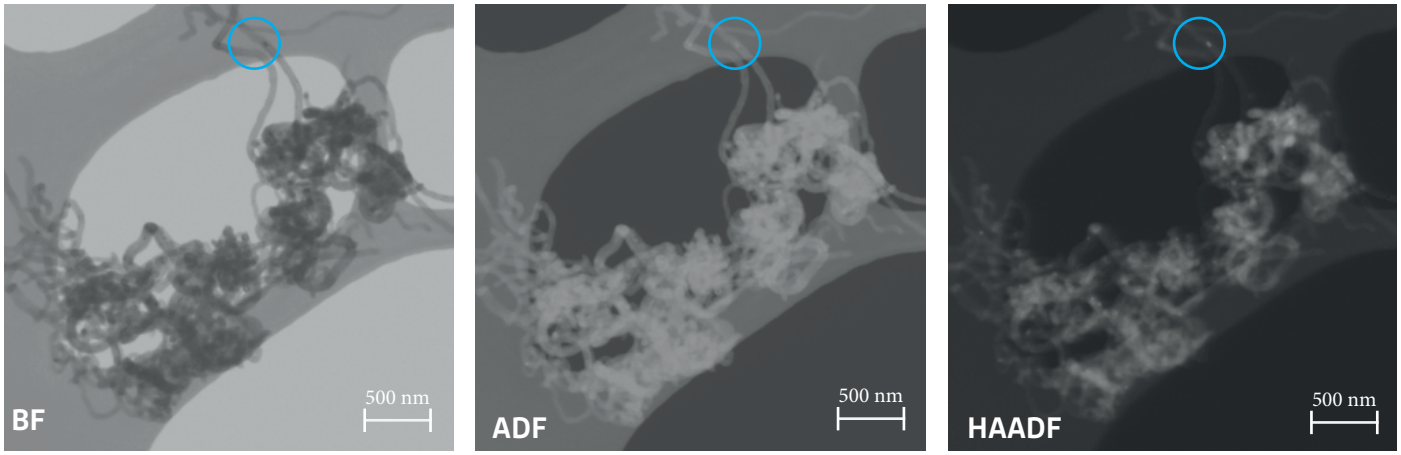
STEM Detector Diodes for SEM and TEM

Scanning Transmission Electron Microscopy (STEM) is a popular technique with growing interest that is applied to a broad variety of specimens in SEM as well as in TEM. Electrons are detected after they have been transmitted through the sample. Depending on the scattering angle and direction, the electrons carry different information about the specimen. Typically, one distinguishes between electrons that leave the sample at angles below the incident beam convergence angle (bright field, BF) and electrons with high (annular dark field, ADF) or very high scattering angles (high angle annular dark field, HAADF).

STEM detectors of different types with bright field or central hole in different dimensions and ring structures. See the table on the next page for more information.

STEM in SEM

In SEM applications the acceptance angles are adjusted by changing the distance between sample and detector. We offer different sizes and shapes of annular STEM detector diodes. All are based on fully depleted pn-diodes with a thickness of 450 µm which minimizes the signal capacitance and therefore enables highest detector speed and lowest noise levels.



STEM images of Carbon Nano Tubes (multi-walled) on Holey Carbon Grid acquired with the 3-ring annular STEM detector STEM-10-4-2-BF05 in SEM at 30 kV and 20 pA primary current . The different segments show different information. High scattering particles can precisely be analyzed in the HAADF image even at these low beam currents which is beneficial for preventing beam damage on the sample.

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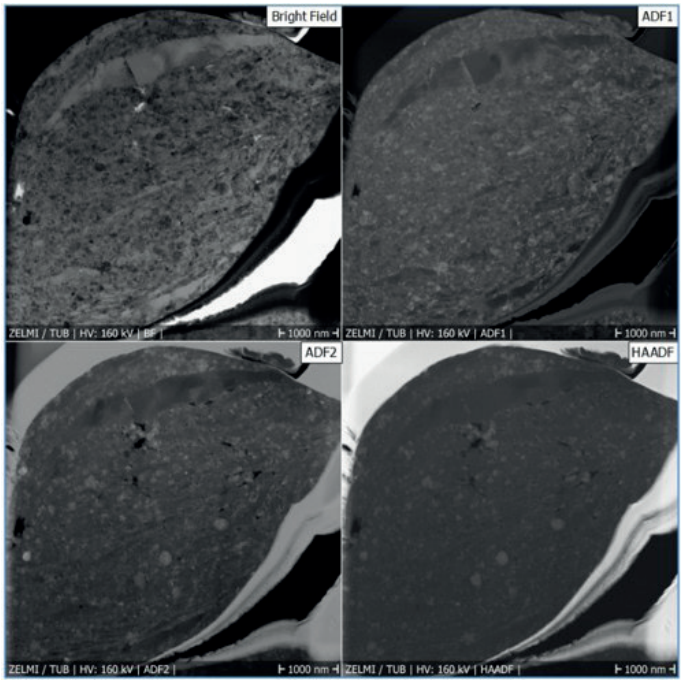
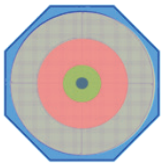
STEM in TEM

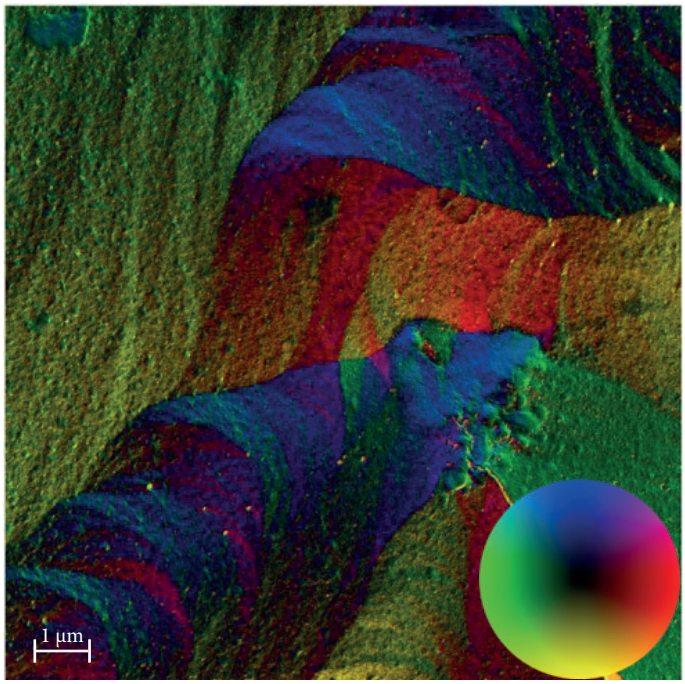
In TEM applications, the acceptance angle can be adapted to the detector size by the electron optics. Our detectors comprise 3 rings which are further divided into quadrants, enabling Differential Phase Contrast (DPC) measurements. These quadrants can also be combined to form one single channel. This guarantees maximum flexibility for the customer. Sensors with central BF cell are available as well as sensors with central hole, through which the central beam can pass to further detectors (e.g. EELS spectrometers).



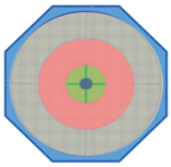
FIB-Lamella of Magnesium flakes with embedded SiC nanoparticles (10-200 nm)
Low difference in mean atomic numbers:
Mg: Z = 12 | MgO : Z= 10 | SiC : Z = 10
[Courtesy of ZELMI (TU Berlin), Sören Selve]



EHT: 160 kV
Detector type:
STEM-22-4-3-BF15: 4-channels
(BF, LAADF, MAADF, HAADF)
Scan speed: 4.5 MHz (220 ns)



Differential Phase Contrast (DPC) color map of a 35 nm thin Cobalt sample
Direction and strength of magnetic domain structures are indicated by colors
[Courtesy of University of Regensburg, Prof. Dr. Zweck]



EHT: 300 kV
Detector type:
STEM-22-4-3-BF15: 7 channels
(BF, 4 quadrant LAADF, MAADF, HAADF)
Scan speed: 80 kHz (12,8 µs)

Available Annular STEM Detectors

Chip Type	BF Cell Diameter	Central Hole Diameter	Number of Segments/ Rings	Ring 1 (Inner Diameter)	Ring 2 (Inner Diameter)	Ring 3 (Inner Diameter)	Outer Diameter
STEM-10-4-2-BF05	0.5 mm	-	4/2	0.5 mm	3.0 mm	-	10.0 mm
STEM-22-4-3-BF15	1.5 mm	-	4/3	1.5 mm	6.0 mm	14.0 mm	22.0 mm
STEM-22-4-3-CH05	-	0.5 mm	4/3	1.5 mm	6.0 mm	14.0 mm	22.0 mm
STEM-22-4-3-CH20	-	2.0 mm	4/3	3.0 mm	6.0 mm	14.0 mm	22.0 mm

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