EBSD

eWARP

The Dawn of a New Era in EBSD Technology

eWARP is a pioneering new EBSD detector powered by a Bruker-engineered camera that combines direct electron detection and CMOS technologies to vastly boost signal acquisition and processing performance, elevating the EBSD technique to new levels.

Using a first principles approach, a hybrid pixel sensor (Figure 1) and control electronics have been designed from scratch to push the limits of detector sensitivity and EBSD analysis speed.

As a result, eWARP is the fastest and most signal efficient EBSD detector ever.

Combined with our ESPRIT software suite, eWARP enables the acquisition of EBSD maps with up to 14,400 patterns per second at electron beam settings as low as 10 kV accelerating voltage and 12 nA probe current.

The unprecedented signal efficiency of eWARP is the result of its uniquely high collection rate, enabled by the wide area pixels, and its outstanding conversion rate as the sensor is silicon-based and optimized for electron energies typically used in SEM.

At the core of eWARP sits the first ever CMOS device with binning capability. When operated in SuperPixel mode, it enables ForeScatter and BackScatter (FSE/BSE) imaging with up to 350,000 patterns/second.

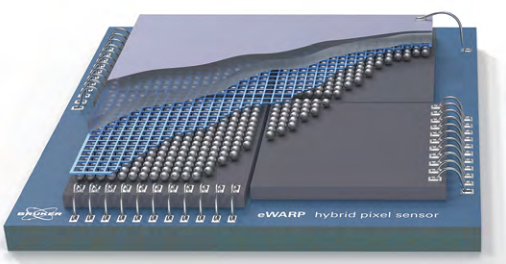


Figure 1
Schematic representation of Bruker's hybrid pixel sensor technology, a.k.a. **W**ide **Ar**ea **P**ixelated (WARP) sensor.

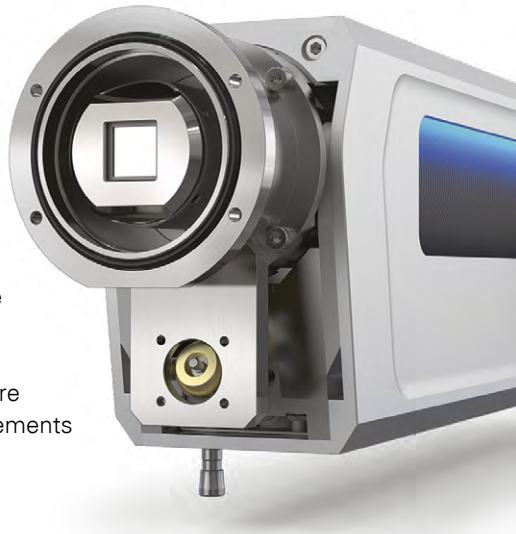
A variety of challenging applications will greatly benefit from the game-changing signal efficiency and speed performance that eWARP offers:

- 3D EBSD – faster automatic acquisition of data cubes, using a plasma FIB-SEM, with higher pixel resolution or covering a larger volume
- Ultra-fine grained materials – enhanced spatial resolution down to at least 20 nm, for resolving the finest features due to reduced accelerating voltage and probe current, even when operating at high speed
- Time resolved mapping – acquisition of repetitive maps and images every few seconds to record microstructural changes inside the sample during in-situ heating and/or mechanical testing experiments
- Large area mapping – analysis of larger regions on the sample and/or analysis with higher pixel resolution
- Beam sensitive materials – EBSD mapping at very low electron doses
- Martensitic or heavily deformed metals and alloys – improved data quality due to reduced interaction volume when operating at lower accelerating voltages, e.g. 10 kV
- Insulating materials – excellent data integrity due to improved beam stability

Beyond the superior analytical performance, eWARP's revolutionary design also guarantees minimized cost of ownership and maximized uptime due to:

- Remote detector monitoring for preventive/predictive maintenance (customer permission required)
- Field-replaceable camera module
- User upgradable firmware for future performance and usability improvements

eWARP – Electrons only



Technical Specifications

Chip technology	CMOS
Detection method	Direct electron detection
Active area/sensor material	16 x 16 mm^2 / silicon
Pixel size/ pitch	160 x 160 μm^2
Dynamic range	15 bit (91db)
Operating beam conditions	Accelerating voltage range: 5 kV – 30 kV Standard/ recommended accelerating voltage: 10 kV, typical probe current required to reach 99% hit rate on an Austenitic steel sample at 10 kV accelerating voltage: ~12 nA
Pixel resolution	Native: 100 x 100 pixels Binned: 10 x 10 pixels (9x9 binning – Patent EP 3605 044 B1 / US 1166 5441 B2)
Minimum integration time/ frame time	2.6 µs / 69 µs
Radiation hardness - expected lifetime	At least 10 years (40 hours/week) at 10 kV accelerating voltage
Cooling system	Active - Peltier

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