PIVECTOR LABS.

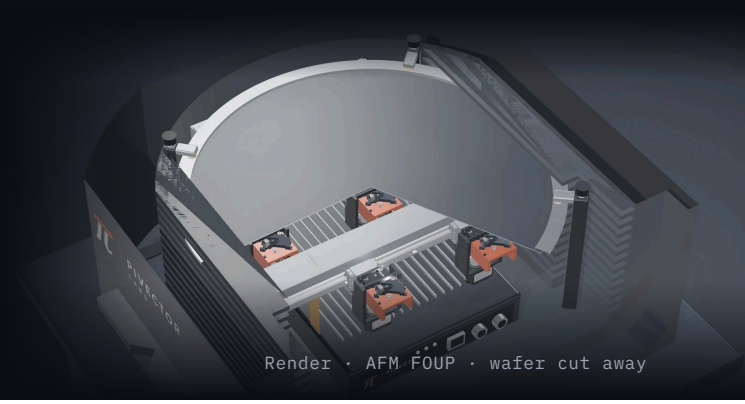
TECHNICAL DATASHEET
REV D · NOVEMBER 2026

FOR HBM AND ADVANCED-PACKAGING FABS

Pivector Multi-Head AFM

High-throughput, FOUP-integrated AFM for 300 mm wafers

PILOT PROGRAM OPEN | FOUP INTEGRATION IN DEVELOPMENT



Render · AFM FOUP · wafer cut away

Overview

The Pivector Multi-Head AFM places many miniaturized atomic force microscope heads over one 300 mm wafer and scans them in parallel. Each tip measures 3D height directly, on copper and dielectric alike, with no optical model to calibrate. The aim is AFM data from many sites on every wafer, where fabs sample a few sites per lot today.

Bond-ready surfaces

PUBLISHED REQUIREMENT[2]	
Cu pad recess	1–3 nm
Dielectric roughness	Rq 0.1–0.2 nm
Dishing	≤ 5 nm
Planarity	≈ 0.5 nm RMS
Edge roll-off	near the edge

20–30 mm
AFM head size
About 100 mm for a conventional head

< 5 Å
Vertical resolution
Per head

40+
AFM heads per wafer
Scanning in parallel

50–100
Area rate, mm²/h
Whole system, 40+ heads

Architecture

Miniaturized sensing heads

AFM heads 20–30 mm across, against about 100 mm for a conventional head, so dozens fit over one wafer.

Parallel operation

Synchronized control, calibration and acquisition across heads, so every head reads the same height on the same feature.

Process tool integration

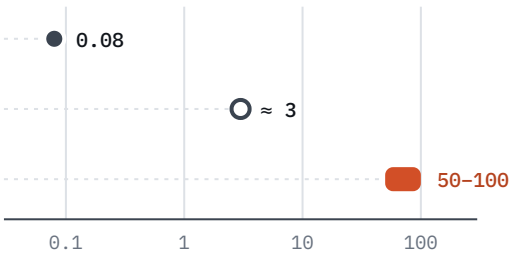
A FOUP-sized module for a standard 300 mm load port, reporting to the fab host over SECS/GEM.

Why parallel heads

Single-tip AFM
80 × 80 µm in about 5 min

40 heads, single-tip speed
Derived, 40 × 0.08

Pivector, 40+ heads
Production system



AFM AREA RATE · MM²/H · LOG SCALE

More heads alone gives about 40× the single-tip rate. Reaching 50–100 mm²/h also needs each head to scan about 15–30× faster than the published benchmark.

Even at that rate, a full 300 mm wafer (≈ 70,700 mm²) would take one to two months. The system samples many sites per wafer; it does not map the whole wafer.

AFM system specifications

SPEC ITEM	DETAILS
Scanning modes	Non-contact / tapping mode (NCHR-type probes)
XY scan range	15 × 15 µm nominal; 90 × 90 µm max (upgrade option)
Z scan range	≈ 10 µm nominal, for high-aspect-ratio structures
Lateral (XY) resolution	< 1.5 nm
Vertical (Z) resolution	< 5 Å (0.5 nm)
Noise floor	< 0.5 Å RMS
Optical microscope	Integrated, max. resolution ≈ 1.6 µm
Probe compatibility For reference only	Nanosensors PointProbePlus-RT-NCHR · tip radius < 7 nm NanoWorld High Aspect Ratio Silicon SPM-Sensor · aspect ratio 10:1 Nanosensors SuperSharpSilicon-NCHR · tip radius < 2 nm
Environment	Ambient air, 1 atm
Max. sample size	Diameter up to 310 mm, thickness < 30 mm; height variation across the sample < 20 µm
Control software	PiScope
Measurement capabilities	2D/3D morphology imaging; step-height profiles (e.g. pattern width and height); surface roughness
Measurement characteristics	Non-destructive; whole wafers up to 300 mm scanned without dicing; solid, flat or sheet-form samples

Parallel scanning

AFM heads scanning in parallel	40+
AFM head size	20–30 mm
Area rate, whole system	50–100 mm²/h
Area rate, per head [1]	≈ 1.25–2.5 mm²/h at 40 heads
Sampling	Many sites on each wafer, edge included

1 Per-head rate needed to reach 50–100 mm²/h with 40 heads. Single-tip benchmark: an 80 × 80 µm image in about 5 minutes, ≈ 0.08 mm²/h (Adeia via 3D InCites, May 2024).

2 Page 1 surface requirements: imec (2024); Besi via SemiEngineering (2026); Bruker application note AN5001.

Specifications are subject to change.

Production module

Form factor	Module in a 300 mm FOUP form factor
Heads	Up to 7 AFM heads on 3 parallel rails (2 + 3 + 2), below the wafer
Wafer	Clamped face-down; heads measure the device side from below
Electronics	Electronics box inside the FOUP, under the heads
Wafer interface	Standard 300 mm load port; wafers stay in the automated flow
Host connection	SECS/GEM
Availability	First AFM FOUP systems planned for 2027

Applications

Hybrid bonding	Cu recess, roughness, dishing and planarity before bonding
CMP	Run-to-run control; hold out-of-window wafers before bonding
HBM	Bond-ready checks on every surface before stacking
Also suited to	SiC wafers, EUV mask blanks, high-NA resist, GAA and CFET



Dual-head prototype in our San Francisco lab, scanning a 300 mm wafer. Height maps from both heads on screen.

Development status

NOVEMBER 2026

DONE	DONE	DONE	IN PROGRESS	OPEN NOW	2027
Automated single-head AFM	20–30 mm miniaturized head	Dual-head prototype on a 300 mm wafer	Dual-head synchronization, calibration and control	Multi-head AFM pilots	First AFM FOUP systems

PILOT PROGRAM OPEN

Run a pilot on your own wafers

Send us samples to measure, run a pilot, or pre-order an early production system. We reply within one business day.

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