

Active Wafer Handling and Flatness Correction



Controlled Surface Shaping Using Piezo-Based Actuation

Warped and bowed substrates disrupt chucking, measurement, and yield throughout wafer processing. This piezo-based active chucks reshape the surface on demand, correcting bow and local deformation through the superposition of the first ten Zernike modes or freely selectable shapes, with long- and short-wavelength stroke and set-and-forget stability from full 300 mm wafers down to millimeter-scale substrates.



Technology Demonstrator

Key Advantages of the System Design

- ✓ **Active Shape Control** — Controlled correction of wafer bow, warpage, and local deformation
- ✓ **Scalable System Design** — Configurable for full wafers and smaller substrates
- ✓ **Flexible Shaping Modes** — Supports long- and short-wavelength deformation



Number of DoFs

First 10 Zernike modes or freely selectable



Stroke

Long-wave: $\pm 100 \mu\text{m}$
Short-wave: $\pm 3 \mu\text{m}$
More stroke upon request



System Sizes

From 300 mm wafers down to a few millimeters



Operation Modes

Highly dynamic and extremely stable set-and-forget operation

Active Wafer Handling and Warpage Correction



CHALLENGE

Warpage

Bent or warped substrates, such as wafers, create challenges during chucking as well as throughout measurement and production processes.

Varying Stroke and Resolution

Different applications demand different specifications for shape control.

Specimen Integrity Risk

Curvature concentrated at kink edges can risk specimen damage, while chucking at individual points can lead to unintended tent-like deformation.



SOLUTION

Active Shape Control

Use of an actively deformable chuck ensures reliable chucking while enabling dynamic adaptation of the substrate shape throughout the process.

Appropriate Amplitude and Pitch

Depending on the application requirements, the solution can provide long- or short-wavelength deformation, or a combination of both.

Smooth Shape Gradients

A stiff support structure ensures smooth shape gradients, with high-resolution, highly repeatable piezo actuators delivering the required deformation forces.



RESULT

Flexible Shapes

Superposition of Zernike modes maps complex and rotatable surface shapes.

Flexible System Sizes

Solutions ranging from entire wafers to arrays just a few millimeters in size, with larger strokes available upon request.

Set and Forget

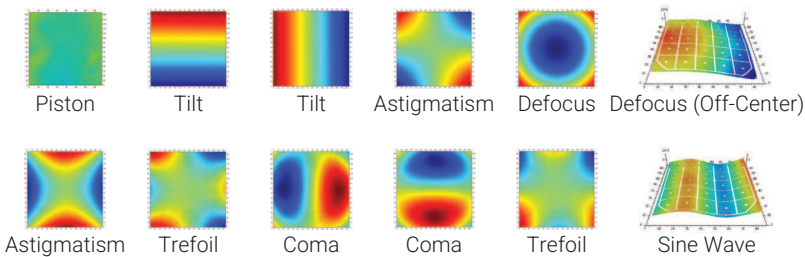
Semi-active (PIRest) operations enable optimized stability and power consumption.

Parameter	Active Wafer Chuck	Piezo Arrays
Number DoFs	10 (Zernike modes up to 3 rd order)	Selectable
Stroke (active operation)	Rigid body motion: up to $\pm 150\text{ }\mu\text{m}$ ** Deformation modes: up to $\pm 100\text{ }\mu\text{m}$ **	Actuator array: $\pm 3\text{ }\mu\text{m}$ Multilayer array: $\pm 1.5\text{ }\mu\text{m}$
Minimal increment motion (closed loop)*	< 15 nm	–
1 st resonant frequency	> 350 Hz	–

* Preliminary specifications

** More strokes available upon request

Surface Measurement Result



LET'S TALK ABOUT YOUR APPLICATION

Discuss your process requirements and the right approach with our experts.

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