MEMS Deformable Mirrors for Adaptive Optics

Nathan Doble

Iris AO, Inc

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Iris AO MEMS Segmented DM

- Robust assembled mirror surface stays flat
- Temperature insensitive bimorphs elevate mirror above substrate
- Piston/tip/tilt electrostatic actuation
Bimorph Flexures

- Engineered stresses create beam shape
- Stroke determined by design, not process
DM Electrostatic Actuators

- Actuators wired to periphery
- Electrostatic forces pull actuators down
- No hysteresis
- 4.2 mm aperture
DM Stroke: Position versus Voltage

- Design flexibility to trade off stroke, voltage and frequency
- Stroke of up to 20 µm
- Low voltage actuation

- High positioning repeatability
Assembled SOI Mirrors: Benefits

• Single crystal mirror has excellent flatness
• Thickness gives rigidity
  ▪ Mirror is still flat after optical coating
  ▪ Stays flat over varying operating conditions
    • Temperature
    • Actuation
• High fill factor
  ▪ Mirrors cover bimorph flexures
  ▪ Etch holes not necessary
Assembled-Mirror Flatness

- Low rms surface errors
- < 8 nm rms on average

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CfAO MEMS workshop
Experimental Deflection (400Hz)