Piezo Technology in Synchrotrons

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CTEC STANDARD PRODUCTS

› Actuators
› Motors
› Piezo
› Magnetic
Piezoelectric effects

Generator or Actuator

\[
\text{0.1 \% Active Deformation:} \\
\quad \text{500 \text{\textmu}m displacement } \rightarrow 0.5 \text{ m piezo stack!}
\]
Piezoelectric effects – APA Linear Actuator

Key figures
- Strokes from 25μm to 2mm
- Forces up to 2kN
- Pulling actuator
- Pre-stress actuator
  - resistance to shock & vibrations
  - no weakness

Example with APA600M
- APA600M – 15 mm height
- Full Stroke @ 170 V range (-20/+150 V)
- Stroke: 600μm
- Active deformation 3.7%
  - x 37 / Piezo ceramic
Fast Piezo Shutter – FPS

History
• First CTEC product developed for the Synchrotron Market
• Collaboration with the EMBL / MAG shutter

Application
• Fast Shutter for X Ray beamlines
• Control/Define the exposure time
  • “Protect” the sample

Example FPS200M
• Beam: Ø 0.30 mm
• Aperture & Closing time: 2 ms
• Low Jitter < 100 μs, Low self heating
Example FPS200M
- Specifications explanation
  - 2 x APA200M
  - Stroke: 200μm / Actuator
  - Mechanical frequency @900 Hz in Blocked-Free
    - Period: 1.1 ms
- Driver Optimized with pre-shaped signal

Higher Beam diameter
- Bigger APA
  - Less Stiff
    - Lower Resonance Frequency
    - Period impacted (increased)
- FPS400M
  - Ø 0.7 mm
  - 4 ms
- FPS900M
  - Ø 1.1mm
  - 10 ms
- If More: Lever Arm!
Fast Amplified Piezo Shutter – FAPS

› **History**
• Developed for PAL, XFEL beamline
• Beam: Ø > 1 mm

› **Application**
• Fast Shutter for beamlines
• Control the exposure time of a sample behind it

› **Specifications**
• Beam: up to Ø 3 mm
• Aperture & Closing time: 8 ms
Example FAPS400M

- 2 x APA400M
  - Stroke: 410 μm
  - Resonance frequency: 380 Hz
  - Period: 2.7 ms
- Lever arm amplifies the movement
  - Stroke: 3 mm
- Opening/Closing time: 8 ms
  - Stiffness
Fast Beam Attenuation Actuator

› History
• Co-design with SOLEIL, SixS beamline

› Application:
• Attenuate the energy of the beam
  ◦ Protect the sensor
  ◦ Avoid sensor saturation

› Specifications:
• 6 Piezo Actuators
• Lever Arms by bending :
  ◦ 120 μm -> 650 μm -> 3 mm
  ◦ x 25 amplification
• Movement done in 10 ms (100 Hz)
Fast Beam Attenuation Actuator
Active Piezo Micro Slits Mechanism

› History
• Co-design with SOLEIL, SWING beamline

› Application:
• Shape the beam section to a rectangle
• Adjust the shape

› Specifications :
• 4 Piezo Actuators with SG Sensors
• Lever Arms by bending :
  ◦ 40 μm -> 66 μm -> 670 mm
  ◦ x 18 amplification
• Movement done in 25 ms (40 Hz)
Active Piezo Micro Slits Mechanism
Active Piezo Micro Slits Mechanism - Sensor

- High Stability required
  - +/- 0,5 μm for 0,5 °C variation
  - Strain Gauges sensors chosen
  - Compact
    - "Patch" Stuck on the piezo stack
    - Space heritage from CTEC
Active Piezo Micro Slits Mechanism - Sensor

Comparison
• Laser vs SG vs Order
Thanks for your attention!

Merci !

Questions?

Come see us at booth #32