The NASA

LangleyEdge

NASA LANGLEY RESEARCH CENTER

Piezoelectric Ceramic Actuator Technologies

Active diaphragms using radial electric fields

NASA Langley Research Center is actively seeking partnerships and collaborations to commercialize its Piezoelectric Ceramic Actuator technologies. These technologies are the latest of the NASA smart material actuators.

The Market Opportunities

Commercial applications for ceramic actuator technologies include:

- Metering and dispensing for:
  - –Medical
  - –Pharmaceutical and cosmetic
  - –Industrial and semi-conductor manufacturing
  - –Food processing
  - –Chemical processing
  - –Paint and ink
  - –Laboratory applications
- Deep underwater and submersibles
- Acoustic transducers

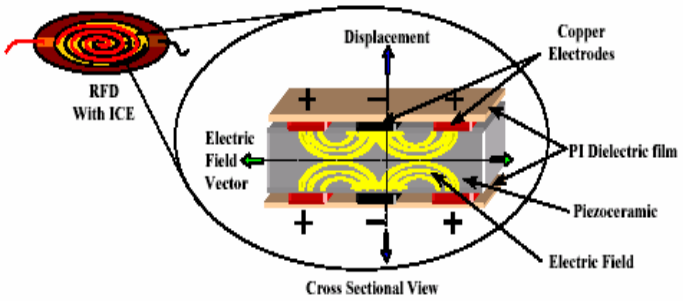
The Benefits

- Controllable stroke profile
- Simple, compact, lightweight, reliable design
- Made from standard, off-the-shelf materials
- Low-cost, repeatable manufacturing processes
- Power efficient and electrically isolated
- Displacements 3 to 4 times that of competing piezoceramic actuators with significantly higher efficiency
- Potential for battery operation and portability
- Can be manufactured in variety of geometric shapes

The Technology

Inventors at Langley Research Center have developed a family of piezoelectric ceramic actuator devices that exhibit dome-like shaping action. These devices can provide displacements that are about 3 to 4 times that of typical unimorph actuators. The device can be easily manufactured using standard off-the-shelf materials and process technologies.

The actuator design has several differences from conventional piezoelectric actuators. Because of its radial design, this actuator exhibits out-of-plane movement when electrically stimulated and does not



transmit any substantial mechanical strain beyond the boundary of the ceramic element. This behavior is distinct from all other "bender" type actuators.

The actuators consist of a piezoelectric ceramic wafer encased in a polymer film onto which an electrode pattern has been etched. One example comprises a thin circular piezoelectric ceramic disk sandwiched between two dielectric films with copper-etched spiral electrodes. On each spiraled electrode pattern, positive and negative electrodes spiral inward to the center of the disk in a serpentine manner. This novel electrode pattern induces an electric field into the piezoceramic that extends out radially from the wafer. The resulting radial electric field causes the piezoelectric wafer to deform in a conical shape, hence the term Radial Field Diaphragm (RFD) is used.

As the latest of the NASA Langley smart material actuators, this actuator retains the advantageous laminate construction and fabrication techniques of its predecessor, the Langley MFC actuator. This actuator possesses several new and unique characteristics, including out-of-plane concentric actuation, unconstrained motion under fixed boundary conditions, and the ability to use solid, unelectroded ceramic plates.

Additional Information

To discuss in detail how this technology can profit you and your business, please contact:

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