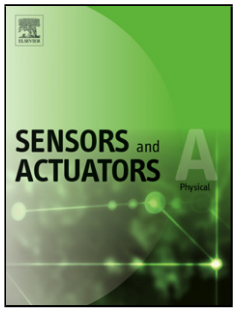

Title: A low-working-field (2kV/mm), large-strain (>0.5%) piezoelectric multilayer actuator based on periodically orthogonal poled PZT ceramics

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PII: S0924-4247(17)32020-4
DOI: https://doi.org/10.1016/j.sna.2018.01.042
Reference: SNA 10597

To appear in: *Sensors and Actuators A*

Received date: 12-11-2017
Revised date: 5-1-2018
Accepted date: 22-1-2018

Please cite this article as: Wang Q, Li F, A low-working-field (2kV/mm), large-strain (>0.5%) piezoelectric multilayer actuator based on periodically orthogonal poled PZT ceramics, *Sensors and Actuators: A Physical* (2010), https://doi.org/10.1016/j.sna.2018.01.042

A low-working-field (2kV/mm), large-strain (>0.5%) piezoelectric multilayer actuator based on periodically orthogonal poled PZT ceramics

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Highlights

- A low-working-field (2kV/mm), large-strain (>0.5%) piezoelectric multilayer actuator was proposed;
- The actuator is based on periodically orthogonal poled PZT ceramics in which reversible domain switching can be realized;
- The large actuation strain is very stable after 20k cycles of operation but drops quickly with increasing frequency;
- The proposed actuator is very promising for low frequency, large strain actuation applications.

Abstract

In this work, we proposed a special designed multilayer actuator based on the periodically orthogonal poled (POP) PZT ceramics. Only the in-plane poled regions of the neighboring PZT layers were bonded together thus the large reversible switching strain in these regions can always be employed. A six-layer actuator was fabricated and testing results show that it can output actuation strains over 0.5% under a low field of 2kV/mm at 0.1Hz, about 3.5 times of that in conventional PZT actuators which is less than 0.15% under the same field. Furthermore, the output large strain is fairly uniform, which varies from 0.50% to 0.53% along the period direction, in comparison with that varying from 0.35% to 0.59% in a single-layer POP PZT. The large actuation strain drops quickly with the increasing frequency, and stabilized at about 0.2% under 2kV/mm at or above 1Hz. The low-frequency large strain is very stable and keeps unchanged after 20k cycles of operation. To solve the charge accumulation problem during successive unipolar loading/unloading, an asymmetric bipolar field from -300V/mm to 2kV/mm is applied and meanwhile the actuation strain turns to be more uniform, only varying from 0.51% to 0.52% at 2kV/mm. The low driving field, large strain of the proposed actuator makes it very promising in low-frequency, large strain/displacement actuation areas.

Keywords: piezoelectric actuators; multilayer; domain switching; PZT

1. Introduction