



Controlling Magnetization Using Patterned Electrodes on Piezoelectrics

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SUMMARY

UCLA researchers in the Department of Materials Science and Engineering have developed a novel piezoelectric thin film that can control magnetic properties of individual magnetic islands.

BACKGROUND

Next generation computer memory and magnetic random access memory (MRAM) devices will rely on controlling magnetic reorientation in individual magnetic islands on piezoelectric thin films. Currently, this control is not yet feasible on thin film piezoelectrics grown on silicon or other substrates because the substrates clamp the in-plane strain, making the piezoelectric strain uniform throughout the layer and thus, the magnetization of all the islands rotate at once.

INNOVATION

UCLA researchers have invented a novel method that uses patterned electrodes on a piezoelectric substrate to generate local strain to control magnetic properties of individual magnetic islands. In this innovative technology, only a small region surrounding the electrode is strained, enabling arrays of indexed magnetic elements to be locally controlled. This invention should be scalable to thin films down to the micro- and nanoscale and will have applications in next generation MRAM devices with low writing energy and fast writing speeds as well as nanoscale motor systems and computer memory devices.

APPLICATIONS

- ▶ Next generation MRAM devices
- ▶ Computer memory devices
- ▶ Nanoscale motor systems

ADVANTAGES

- ▶ Achieves highly localized biaxial strain, allowing control over individual magnetic islands
- ▶ Induces local strain in piezoelectric thin films via patterned electrodes
- ▶ Memory devices with low writing energy and fast writing speeds
- ▶ Scalable down to the micro- and nanoscale

STATE OF DEVELOPMENT

A prototype of this technology has been developed and extensively tested. Future plans include scaling the electrode pattern design down to the micro- and nanoscale for computer memory device applications.

RELATED MATERIALS

- ▶ J. Cui, J. L. Hockel, P.K. Nordeen, D. M. Pisani, C.-Y. Liang, G. P. Carman, and C. S. Lynch. A Method to Control Magnetism in Individual Strain-Mediated Magnetoelectric Islands, Applied Physic Letters, 2013.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,685,214	06/20/2017	2014-181

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.



INVENTORS

- ▶ Lynch, Christopher S.

OTHER INFORMATION

KEYWORDS

Magnetization, magnetic islands, patterned electrodes, piezoelectrics, biaxial strain, localized strain, magnetic random access memory, MRAM, nanomotor systems, computer memory devices

CATEGORIZED AS

- ▶ **Engineering**
 - ▶ Engineering
 - ▶ Other
- ▶ **Materials & Chemicals**
 - ▶ Electronics Packaging
 - ▶ Nanomaterials
 - ▶ Other
 - ▶ Thin Films
- ▶ **Nanotechnology**
 - ▶ Electronics
 - ▶ Materials
 - ▶ Other
 - ▶ Tools and Devices
- ▶ **Semiconductors**
 - ▶ Design and Fabrication
 - ▶ Materials
 - ▶ Other

RELATED CASES

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Phase Transformation in Ferroelectric Piezocrystals](#)
- ▶ [Self-Latching Piezocomposite Actuator](#)

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UCLA Technology Development Group

10889 Wilshire Blvd., Suite 920, Los Angeles, CA 90095

tdg.ucla.edu

Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu

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