

Accepted Manuscript

A multi-scale and multi-field coupling nonlinear constitutive theory for the layered magnetoelectric composites

Hao Xu , Yongmao Pei , Faxin Li , Daining Fang

PII: S0022-5096(17)30804-9
DOI: [10.1016/j.jmps.2018.02.016](https://doi.org/10.1016/j.jmps.2018.02.016)
Reference: MPS 3290



To appear in: *Journal of the Mechanics and Physics of Solids*

Received date: 11 September 2017
Revised date: 24 January 2018
Accepted date: 26 February 2018

Please cite this article as: Hao Xu , Yongmao Pei , Faxin Li , Daining Fang , A multi-scale and multi-field coupling nonlinear constitutive theory for the layered magnetoelectric composites, *Journal of the Mechanics and Physics of Solids* (2018), doi: [10.1016/j.jmps.2018.02.016](https://doi.org/10.1016/j.jmps.2018.02.016)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

A multi-scale and multi-field coupling nonlinear constitutive theory for the layered magnetoelectric composites

Hao Xu^{a,b}, Yongmao Pei^{a,*}, Faxin Li^a, Daining Fang^{a,c,**}

^a*State Key Laboratory for Turbulence and Complex Systems, College of Engineering, Peking University, Beijing 100871, China*

^b*National Institute of Metrology, Beijing 100029, China*

^c*Institute of Advanced Technology, Beijing Institute of Technology, Beijing 100081, China*

Abstract : The magnetic, electric and mechanical behaviors are strongly coupled in magnetoelectric (ME) materials, making them great promising in the application of functional devices. In this paper, the magneto-electro-mechanical fully coupled constitutive behaviors of ME laminates are systematically studied both theoretically and experimentally. A new probabilistic domain switching function considering the surface ferromagnetic anisotropy and the interface charge-mediated effect is proposed. Then a multi-scale multi-field coupling nonlinear constitutive model for layered ME composites is developed with physical measurable parameters. The experiments were performed to compare the theoretical predictions with the experimental data. The theoretical predictions have a good agreement with experimental results. The proposed constitutive relation can be used to describe the nonlinear multi-field coupling properties of both ME laminates and thin films. Several novel coupling experimental phenomena such as the electric-field control of magnetization, and the magnetic-field tuning of polarization are observed and analyzed. Furthermore, the size-effect of the electric tuning behavior of magnetization is predicted, which demonstrates a competition mechanism between the interface strain-mediated effect and the charge-driven effect. Our study offers deep insight into the coupling microscopic mechanism and macroscopic properties of ME layered composites, which is benefit for the design of electromagnetic functional devices.

Keywords: Magnetoelectric materials; multi-field coupling; nonlinear; constitutive theory; size-dependent.

* Corresponding authors.

E-mail addresses: peiym@pku.edu.cn (Yongmao Pei), fangdn@pku.edu.cn (Daining Fang)

Download English Version:

<https://daneshyari.com/en/article/7177457>

Download Persian Version:

<https://daneshyari.com/article/7177457>

[Daneshyari.com](https://daneshyari.com)