

Accepted Manuscript

A numerical framework for modeling flexoelectricity and Maxwell stress in soft dielectrics at finite strains

J. Yvonnet, L.P. Liu

PII: S0045-7825(16)30690-9

DOI: <http://dx.doi.org/10.1016/j.cma.2016.09.007>

Reference: CMA 11119

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 6 July 2016

Revised date: 6 September 2016

Accepted date: 12 September 2016

Please cite this article as: J. Yvonnet, L.P. Liu, A numerical framework for modeling flexoelectricity and Maxwell stress in soft dielectrics at finite strains, *Comput. Methods Appl. Mech. Engrg.* (2016), <http://dx.doi.org/10.1016/j.cma.2016.09.007>

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 numerical framework for modeling flexoelectricity and Maxwell stress in soft dielectrics at finite strains

J. Yvonnet¹ *, L.P. Liu²

^{a1} *Université Paris-Est, Laboratoire Modélisation et Simulation Multi Échelle MSME UMR 8208 CNRS, 5 bd Descartes, F-77454 Marne-la-Vallée, France.*

^{b2} *Department of Mathematics, Rutgers University, NJ 08854, United States*

^{c3} *Department of Mechanical and Aerospace Engineering, Rutgers University, NJ 08854, United States*

Abstract

In the present work, a numerical finite element framework is introduced to model and solve the response of nonlinear soft dielectrics, including the effects of Maxwell stress and flexoelectricity at finite strains. Weak forms, finite element discretizations and consistent linearizations, able to handle strain gradient in the context of flexoelectricity are introduced. Numerical algorithms for the treatment of a soft dielectric in a surrounding medium are presented, more specifically to handle the effects of discontinuities of the Maxwell stress at the interfaces. Finally, several benchmarks are proposed to assess the present formulations and numerical schemes, through applications of special cases of interest: induced piezoelectricity in non-piezoelectric materials due to coupling of Maxwell stress and electrets, flexoelectricity, or stretching of electroactive soft dielectrics subjected to an external electric field.

Key words: Flexoelectricity, Dielectrics, Finite Elements, Nonlinear dielectrics, Maxwell stress, Finite strains

1 Introduction

Soft dielectrics have recently attracted a growing attention due their ability to generate large deformations when they are subjected to an electric voltage.

* Correspondance to J. Yvonnet

Email address: julien.yvonnet@univ-paris-est.fr (J. Yvonnet¹).

Download English Version:

<https://daneshyari.com/en/article/4963924>

Download Persian Version:

<https://daneshyari.com/article/4963924>

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