

Accepted Manuscript

Development of a predictor for fatigue crack nucleation of dielectric viscoelastomers under electromechanical loads

Jianyou Zhou , Liying Jiang

PII: S0022-5096(18)30424-1
DOI: [10.1016/j.jmps.2018.07.012](https://doi.org/10.1016/j.jmps.2018.07.012)
Reference: MPS 3391



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

Received date: 22 May 2018
Revised date: 15 July 2018
Accepted date: 15 July 2018

Please cite this article as: Jianyou Zhou , Liying Jiang , Development of a predictor for fatigue crack nucleation of dielectric viscoelastomers under electromechanical loads, *Journal of the Mechanics and Physics of Solids* (2018), doi: [10.1016/j.jmps.2018.07.012](https://doi.org/10.1016/j.jmps.2018.07.012)

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.

Development of a predictor for fatigue crack nucleation of dielectric viscoelastomers under electromechanical loads

Jianyou Zhou, Liying Jiang*

Department of Mechanical and Materials Engineering,
The University of Western Ontario, London, Ontario N6A 5B9, Canada

E-mail: lyjiang@uwo.ca

*Corresponding author

Abstract

Capable of yielding large deformation under electrical stimuli, dielectric elastomers (DEs) have extensive applications. In most applications, DEs undergo cyclic or time-varying loads over a long period. As a result, durability and fatigue analysis of DEs is a critical issue needs to be addressed. However, there are few models in the literature for predicting the fatigue damage of materials subjected to electromechanical coupled field. Moreover, the existing models fail to capture the effect of the intrinsic viscoelasticity of elastomers. The current work aims to bridge this gap. A configurational stress tensor for DEs is formulated for the first time and adopted as a predictor for their fatigue crack nucleation, which is based on the theoretical framework of configurational mechanics. Borrowing the ideas from the coupled field theory for dielectrics and the theory of finite-deformation viscoelasticity, the developed predictor can adopt most of the strain energy density functions for rubber-like materials and thermodynamics evolution equations for viscoelastic solids. With the developed fatigue predictor, the effects of different factors that may contribute to the fatigue damage of DEs are examined. It is found that the electrical part and the viscous part of the configurational stress do not lead to fatigue damage of DEs. Furthermore, simulation results show that the strain-softening behavior of elastomers exert a significant effect on the fatigue life of DEs. The modeling framework in this work is anticipated to be a useful platform for further study on the fatigue life of DEs under different loading conditions, and even applicable to other soft materials when subjected to coupled loads.

Keywords: Dielectric elastomers; fatigue crack nucleation; configurational mechanics; viscoelasticity.

Download English Version:

<https://daneshyari.com/en/article/7177375>

Download Persian Version:

<https://daneshyari.com/article/7177375>

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