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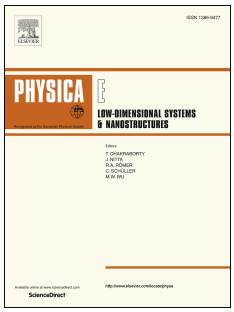

Improved incorporation of strain gradient elasticity in the flexoelectricity based energy harvesting from nanobeams

Yarong Zhou, Xu Yang, Dongmei Pan, Binglei Wang

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Improved incorporation of strain gradient elasticity in the flexoelectricity based energy harvesting from nanobeams

Yarong Zhou[a], Xu Yang[a], Dongmei Pan[b], BingleiWang[a,c,*]

[a]School of Civil Engineering, Shandong University, Jinan, 250061, China

[b]Department of Civil and Environmental Engineering, University of Houston, Houston, TX 77204, USA

[c]Department of Mechanical Engineering, University of Houston, Houston, TX 77204, USA

Abstract

Flexoelectricity, the coupling of strain gradient and polarization, exists in all the dielectric materials and numerous models have been proposed to study this mechanism. However, the contribution of strain gradient elasticity has typically been underestimated. In this work, inspired by the one-length scale parameter model developed by Deng et al. [19], we incorporate three length-scale parameters to carefully capture the contribution of the purely mechanical strain gradients on flexoelectricity. This three-parameter model is more flexible and could be applied to investigate the flexoelectricity in a wide range of complicated deformations. Accordingly, we carry out our analysis by studying a dielectric nanobeam under different boundary conditions. We show that the strain gradient elasticity and flexoelectricity have apparent size effects and significant influence on the electromechanical response. In particular, the strain gradient effects could significantly reduce the energy efficiency, indicating their importance and necessity. This work may be helpful in understanding the mechanism of flexoelectricity at the nanoscale and sheds light on the flexoelectricity energy harvesting.

Keywords: Flexoelectricity; Strain gradient elasticity; Energy harvesting; Piezoelectricity

1 Introduction

Piezoelectricity, one of most important electromechanical coupling phenomena

*Corresponding author. E-mail: bwang@sdu.edu.cn (B. Wang). Tel: +86-531-88392812