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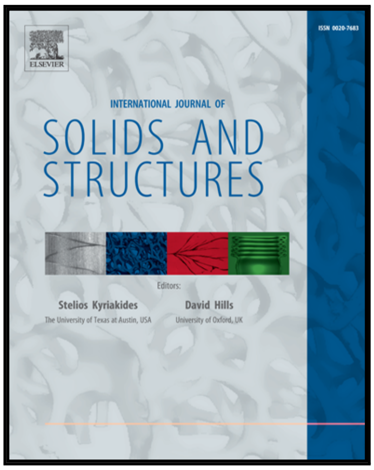

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Stacked dielectric tubes with electromechanically controlled radii

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Abstract

This work examines the features and capabilities of a tube comprised of stacked cylindrical dielectric layers separated by flexible electrodes with the applicative aim of electrically controlling the inner radius. The study begins with the analysis of the non-homogenous electromechanical response of a single-layer dielectric tube according to well-established coupled models. Two boundary conditions are examined - traction free boundaries and a fixed outer radius. The advantages and limitations of each boundary conditions are discussed. It is shown that dielectric tubes subjected to traction free boundaries experience instabilities, an effect that can be avoided by fixing the outer surface. Next, the electromechanical behavior of a stacked cylindrical actuator comprised of dielectric tubes that are mechanically connected in series and electrically connected in parallel is determined under the two boundary conditions discussed above. It is shown that the stacking of cylindrical layers increases the range of available inner radii at the cost of design limitations. Interestingly, it is found that mounting layers on a stacked cylindrical actuator may lead to instabilities even if the outer radius is fixed.

Keywords: electro-active polymers, smart materials, stacked dielectrics

1 Introduction

Electro-active polymers (EAPs) are materials that deform as a result of electric excitation. These elastomers possess many promising properties such as low density, flexibility, ability to undergo large deformations, fast response and availability. Therefore, EAPs are employed in many actuation-based applications such as artificial muscles (Bar-Cohen, 2001), energy-harvesting

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