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# Nonlinear electro thermo elastic analysis of a thick spherical functionally graded piezoelectric shell

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## Abstract

The present paper develops nonlinear thermo electro elastic analysis of a thick spherical shell for the functionally graded piezoelectric materials. The assumed structure is loaded under thermal, electrical and mechanical loads. The mechanical, thermal and electrical properties are graded along the radial direction based on a power function. Primarily, the non homogenous heat transfer equation was solved by applying the general boundary conditions, individually. Geometric nonlinearity has been considered in strain displacement relations using Von-Karman equation. Substitution of nonlinear stress, strain, electrical displacement and material properties in equilibrium and Maxwell equations presents two nonlinear and non homogenous differential equation of order two. The main objective of the present study is considered to improve the relations between mechanical and electrical loads using a nonlinear analysis in spherical shells especially for functionally graded piezoelectric materials. The effect of employed nonlinear analysis can be studied on the results by a comprehensive comparison between them and corresponding linear results. The percentage of improvement of the nonlinear results rather than linear results can justify necessity of this nonlinear analysis. This improvement is important in design and calibration of sensors in order to receive more accurate results.

**Keywords:** *piezoelectric, thick spherical shell, functionally graded piezoelectric material, non homogenous, sensor.*

## 1 Introduction

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