Notification No: 576/2025
Date of Award: 17-03-2025

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Topic of Research: "A Study of Multiple Cracks in Piezoelectric Materials"

Findings

The entire work is organized into seven chapters. **Chapter 1** provides a general introduction to the fracture mechanics of piezoelectric materials and their applications.

Chapter 2 discusses a comprehensive study of piezoelectric materials, detailing their working principles, polarization mechanisms, and electric boundary conditions. It introduces sectionally holomorphic functions and the Hilbert problem with linear relationships. The mathematical formulation of Stroh formalism for piezoelectric media using complex variable techniques is developed, alongside a historical overview.

Chapter 3 investigates three symmetric collinear straights cracks in piezoelectric materials under combined mechanical and electrical loading. An analytical solution is derived using the complex variable method, considering saturation-limit electric displacement value D_S. Expressions for fracture parameters are obtained, graphically presented, analyzed, and summarized for various piezoelectric ceramics.

Chapter 4 develops a strip saturation zone model for a piezoelectric plate with three collinear impermeable cracks under linearly varying electric displacement. Using Stroh formalism and complex variable methods, analytical expressions for fracture parameters are derived. A numerical study illustrates the effect of linear electric displacement variation on saturation zone length.

Chapter 5 presents a fundamental solution for three collinear cracks in a piezoelectric plate under electromechanical loading. Saturation zones under quadratically varying electric displacement are analyzed numerically, with results for COD and COP graphically presented.

Chapter 6 develops a model for three collinear cracks in piezoelectric materials under combined electrical and mechanical loading. It examines yield and saturation zones, considering cases

where one dominates the other. Using complex variable methods, closed-form expressions for fracture parameters are derived. Numerical results for various materials are graphically presented, analyzed, and summarized to highlight key fracture behaviors.

In **chapter 7** analyzes three collinear mode-I cracks in transversely isotropic piezoelectric materials using Stroh formalism and complex variable methods under semi-permeable electric boundary conditions. It examines electric saturation and mechanical yield zones in two cases, deriving analytical expressions for COD and COP. Numerical results for various ceramics are graphically presented, offering insights into electromechanical behavior.