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Experimental characterization of rate dependent non-linear behavior on macro-fiber composites

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The increasing automation in automobile and aerospace engineering, lead the rapid development of flexible Macro-Fiber Composites (MFCs) for sensing and actuating applications. MFCs consist of rectangular piezoceramic fibers embedded in a polymer matrix, referred to as active layer which is sandwiched between various protective and electrode layers. The high mechanical flexibility, increased strength, reliability and environmentally sealed packaging have made MFCs favorable for applications like vibration control, structural health monitoring, and energy harvesting and structural morphing. In order to increase the utilities of the MFCs in smart structures it is necessary to understand the material behavior of MFCs. However, the data available in the literature as well as from the manufacturer is limited to linear and quasi static behavior. The piezoelectric material behavior has a significant dependence of the rate of applied load and exhibits a hysteresis even for a low load. In the present work, an attempt has been made to study the performance behavior of MFCs subjected to higher electric fields at different rates. To achieve this, experiments are performed on the commercially available MFCs (M2814-P1 and M2814-P2 type MFCs) under pure electrical loading for various voltage ranges and frequencies. The coupling constants are evaluated by measuring the induced strain in the longitudinal direction by using both contact (strain gauge) and non-contact (Digital Image Correlation-DIC) type strain measurements for giving electric field. It is observed that, the voltage range and frequency have a greater influence on the coupling constants of MFC. Also, butterfly (strain vs. electric field) and dielectric hysteresis (electric displacement vs. electric field) loops are observed while operating MFCs in higher electric field.

Biography

S Sreenivasa Prasath is pursuing PhD in the Department of Applied Mechanics at Indian Institute of Technology Madras, India. He has obtained under graduate program in Aeronautical Engineering from Kumaraguru College of Technology Coimbatore, affiliated to Anna University, India, in 2011. His current fields of interests are smart composites, Material characterization and coupled-field problems.

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