Advancements in Research into Piezoelectric Energy Harvesting Insights from the Research Group of Materials Science and Engineering Department

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This unveils the remarkable progress in piezoelectric energy harvesting conducted by piezoelectric energy harvesting research group of the Department of Material Science and Engineering at the University of Moratuwa. Energy harvesting research seamlessly transforms from macro to nano levels based on international trends while emphasizing the critical aspect of system efficiency. At the macro level, a sophisticated vibration energy harvesting device designed for vehicles takes center stage. Lead zirconate titanate (PZT) was strategically chosen as the piezoelectric material, and analysis of vibration sources was undertaken to pinpoint resonant frequencies. This investigation led to the development of a robust prototype utilizing a cantilever-type configuration, wherein the Euler–Bernoulli beam theory and finite element analysis played pivotal roles in optimizing design parameters. The theoretical modeling predicted a maximum voltage, setting the stage for the practical implementation of the prototype on a motorbike. The measured output not only validated the theoretical predictions but also highlighted the real-world applicability of the macro-scale piezoelectric energy harvesting device, particularly in the context of vehicular vibrations.

Based on the international trends, it seamlessly transformed into the nano-scale realm, exploring vertically integrated zinc oxide piezoelectric nanowire arrays. Leveraging COMSOL Multiphysics software, the study modeled and simulated various nanogenerator structures. Here, the focus shifts from sheer nanowire quantity to the nuanced consideration of nanowire density, revealing that the total electric energy harvested is intricately linked to density rather than the absolute number of nanowires. This shift in scale, from macro to nano, is not just a change in dimension but a deliberate evolution in understanding and optimizing piezoelectric systems. The presentation underscores a holistic journey, from macro-level vibrational energy harvesting in practical vehicular applications to the intricacies of nano-level structures, all the while emphasizing the paramount importance of system efficiency in advancing the frontiers of piezoelectric research.

Keywords: PZT, Vibration energy harvesting, Cantilever beam, Zinc Oxide Nanowire, Finite Element Analysis, Piezoelectric Nanogenerator

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