Commentary
Volume 14:4, 2023

Journal of Biosensors & Bioelectronics

ISSN: 2155-6210

Open Access

Methods for Assessing Losses in Piezoelectric Materials

Niharika Alferov*

Department of Bioelectronics, Tula State University 1, 300012 Tula, Russia

Introduction

Ultrasonic motors used in smartphones, piezoelectric voltage transformers and a variety of automotive industry actuators and sensors are examples of electronic devices with piezoelectric sub-devices or compartments. Piezoelectricity is the linear conversion of mechanical and electrical energy and its primary effects are as follows: immediate and banter. Direct alludes to the capacity of piezoelectric materials to produce electrical charges under mechanical pressure, while talk impact is the capacity to twist precisely under an applied electric field [1]. Piezoelectric compartments are known to be better than customary electromagnetic compartments, since they can give a higher volume power thickness (power per unit volume) on a small size (under 1 cm^3). In any case, the bottleneck of piezoelectric gadgets is known to be heat dispersal, which blocks further scaling down of piezoelectric compartments because of energy misfortune. Therefore, it is essential to reduce the heat dissipation of piezoelectric materials and comprehend the mechanism of heat generation in order to advance toward high power density. Piezoelectric materials play a critical role in a wide range of applications, from sensors and actuators to energy harvesting and medical devices. However, these materials are not without their limitations, one of which is the presence of losses that can significantly impact their performance. Losses in piezoelectric materials can arise due to various factors, including material properties, structural imperfections and environmental conditions. Accurate assessment and understanding of these losses are crucial for optimizing device efficiency, reliability and overall functionality [2,3].

Description

Losses in piezoelectric materials lead to dissipation of energy in the form of heat rather than efficient conversion between mechanical and electrical energy. These losses can manifest as hysteresis, dielectric and mechanical losses. Hysteresis losses occur due to the irreversible reorientation of domain walls in response to changing electric fields, resulting in energy dissipation. Dielectric losses are associated with the resistance encountered by the material as it responds to alternating electric fields, causing energy to be converted into heat. Mechanical losses, often related to damping in the material, occur when mechanical energy is converted into heat during vibrations. Various methods have been developed to assess losses in piezoelectric materials, each with its strengths and limitations [4]. One common approach involves impedance analysis, where the electrical impedance of the material is measured over a range of frequencies. By analyzing the impedance spectrum, researchers can separate different loss mechanisms and estimate their contributions to the overall losses. Another method is based on the resonant frequency and quality factor measurements of piezoelectric devices. Changes in the resonant frequency and quality factor can provide insights into the amount of energy dissipated as losses. Material characterization techniques, such as dynamic mechanical analysis and dielectric spectroscopy, also offer valuable information about losses. Dynamic mechanical analysis measures the mechanical response of a material to a range of frequencies and temperatures, providing insights into mechanical losses. Dielectric spectroscopy, on the other hand, focuses on the response of the material to varying electric fields and frequencies, helping to quantify dielectric losses [5].

Conclusion

The assessment of losses in piezoelectric materials is essential for understanding their behavior and optimizing their performance across various applications. Different techniques, including impedance analysis, resonant frequency measurements, dynamic mechanical analysis and dielectric spectroscopy, offer insights into the various loss mechanisms present in these materials. By gaining a deeper understanding of losses, researchers and engineers can make informed decisions in designing and fabricating piezoelectric devices with enhanced efficiency, reliability and overall effectiveness. As technology continues to advance, the development of accurate and efficient loss determination methods remains a crucial area of research in the field of piezoelectric materials and devices.

Acknowledgement

None.

Conflict of Interest

There are no conflicts of interest by author.

References

1. Park, Yoonsang, Yuxuan Zhang, Maryam Majzoubi and Timo Scholehwar, et al. "Improvement of the standard characterization method on k33 mode piezoelectric specimens." *Sens Actuator A Phys* 312 (2020): 112124.
2. Uchino, Kenji, Yuan Zhuang and Seyit O. Ural. "Loss determination methodology for a piezoelectric ceramic: New phenomenological theory and experimental proposals." *J Adv Dielectr* 1 (2011): 17-31.
3. Ural, Seyit O., Safakcan Tuncdemir, Yuan Zhuang and Kenji Uchino. "Development of a high power piezoelectric characterization system and its application for resonance/antiresonance mode characterization." *Jpn J Appl Phys* 48 (2009): 056509.
4. Zhuang, Yuan, Seyit O. Ural, Safakcan Tuncdemir and Ahmed Amin, et al. "Analysis on loss anisotropy of piezoelectrics with∞ mm crystal symmetry." *Jpn J Appl Phys* 49 (2010): 021503.
5. Ikeda, Takuro. "On the relations between electromechanical coupling coefficients and elastic constants in a piezoelectric crystal." *Jpn J Appl Phys* 11 (1972): 463.

***Address for Correspondence:** Niharika Alferov, Department of Bioelectronics, Tula State University 1, 300012 Tula, Russia, E-mail: niharika@yahoo.com*

Received: 02 August, 2023, Manuscript No. jbsbe-23-111838; **Editor Assigned:** 04 August, 2023, PreQC No. P-111838; **Reviewed:** 16 August, 2023, QC No. Q-111838; **Revised:** 21 August, 2023, Manuscript No. R-111838; **Published:** 28 August, 2023, DOI: 10.37421/2155-6210.2023.14.401

How to cite this article: Alferov, Niharika. "Methods for Assessing Losses in Piezoelectric Materials." *J Biosens Bioelectron* 14 (2023): 401.