PÔSTER - RESUMO - DISPOSITIVOS ELETRÔNICOS, ELETROQUÍMICOS, SUPERCAPACITORES E BATERIAS

DEVELOPMENT OF AN AUTOMATED PLATFORM FOR THE CHARACTERIZATION OF PIEZOELECTRIC AND TRIBOELECTRIC POLYMER NANOGENERATORS

Gabriel Mendes Lopes (gabriel.mendes-lopes@unesp.br)

Vitor Hugo Uzeloto Fernandes Mingroni (v.mingroni@unesp.br)

Mateus Dassie Maximino (mateus.maximino@unesp.br)

Clarissa A. Olivati (clarissa.olivati@unesp.br)

Deuber Lincon Da Silva Agostini (deuber.agostini@unesp.br)

Organic electronics has enabled the development of flexible, lightweight, and sustainable devices, particularly polymer-based piezoelectric and triboelectric nanogenerators (PENGs and TENGs) for mechanical energy harvesting. However, the accurate electrical characterization of these systems remains a major challenge due to the ultra-low signal levels generated (pico to femtoampere range), capacitive/inductive effects intrinsic to polymers, and poor reproducibility associated with manual mechanical excitation1,2. This work presents the development of an integrated hardware–software platform designed for the automated characterization of piezoelectric and triboelectric polymers, with emphasis on nanogenerator performance analysis. The mechanical excitation system operates in a closed-loop configuration using a double-acting pneumatic piston, solenoid valve, and high-precision load cell controlled by an Arduino microcontroller. Real-time force feedback allows

precise control of applied force, pressure, and frequency, ensuring high reproducibility and eliminating operator-dependent variability. Complementarily, a dedicated software, PiezoPeakAnalyzer (PPA), was developed in Java 24 using JavaFX for an interactive graphical interface. The software processes time-resolved voltage (V–t) and current (i–t) data from CSV/TXT files, employing sliding-window peak detection algorithms and high-precision BigDecimal computation to accurately analyze ultra-low electrical signals (~10?¹4 A). Instantaneous and integrated power outputs are automatically calculated (P = V•i), enabling a more realistic assessment of nanogenerator performance compared to conventional manual analyses. Preliminary results demonstrate significant differences between automated and non-automated data processing, revealing systematic underestimation of generated power when dynamic signal behavior is neglected. The platform is adaptable for PVDF-based materials, electrospun nanofibers, hybrid PENG/TENG systems, and emerging organic functional polymers. The proposed system contributes to methodological standardization, improved metrological reliability, and accelerated development of high-performance organic nanogenerators. Furthermore, its technological innovation potential supports patent filing and software registration, strengthening research infrastructure in organic electronics and energy harvesting.

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Palavras-chave: pvdf; energy harvesting; closed-loop control; low-current measurement.