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

SYNTHESIS OF CARBON ELECTRODES BY LASER PYROLYSIS: FABRICATION, CHARACTERIZATION, AND APPLICATIONS

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This work investigates the synthesis, structural characterization, and electrochemical performance of porous carbon electrodes produced by direct laser pyrolysis using a commercial laser platform. The study focuses on optimizing key processing parameters — including laser power, scanning speed, and spatial resolution — to achieve efficient, reproducible carbonization of various precursors into conductive carbon architectures suitable for electronic and electrochemical devices.

Kapton was employed as a reference substrate due to its aromatic backbone, which promotes the formation of highly graphitized carbon during pyrolysis. Its chemical stability, purity, and reproducibility make it an ideal benchmark material for validating equipment performance and establishing optimized processing conditions. Given its widespread use in Laser-Induced Graphene (LIG) fabrication (LIN, 2014; ZHANG, 2023), Kapton serves as an internal control for direct comparison with the state of the art.

To expand the scope toward sustainable materials, cellulose filter paper was investigated as a renewable, low-cost alternative carbon precursor. Its intrinsic porosity and flexibility make it particularly attractive for disposable and portable

electrochemical platforms, such as paper-based analytical devices. The feasibility of laser-induced carbonization of cellulose was evaluated as a green synthetic route to low-cost carbon electrodes (SANTHIAGO, 2017)

Furthermore, cellulose substrates were functionalized with Polypyrrole (PPy), an intrinsically conductive polymer (BUFON, 2006). We hypothesize that the conjugated backbone of PPy acts as a structural template during laser pyrolysis, promoting the formation of highly graphitized carbon while infiltrating and reinforcing the porous paper network. In addition, the nitrogen atoms naturally present in PPy are incorporated into the carbon framework, yielding nitrogen-doped carbon structures with enhanced electronic and electrochemical properties. This synergistic strategy enables the fabrication of dense yet high-surface-area electrodes with improved electrochemical activity.

Overall, this study establishes a versatile, scalable laser-based approach for tailoring carbon electrodes from diverse precursor classes, ranging from synthetic polymers to sustainable biopolymers. The results demonstrate the potential of this method for developing advanced, low-cost electrochemical devices.

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Palavras-chave: laser-induced graphene; cellulose; polypyrrole.