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I-CReST 2025: 144-107– Raman and CHNS-Based Elucidation of Carbon Development in Banana Peel Biomass for Sustainable Carbon Materials

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ABSTRACT

The growing demand for sustainable materials in environmental and energy applications has led to increased interest in agricultural waste, particularly for producing activated carbon (AC). While conventional AC is derived from non-renewable sources like coal and petroleum coke, agricultural biomass such as banana peels offers a green and sustainable alternative due to its rich lignocellulosic content. This study investigates the carbon development characteristics of banana peel biomass through Raman Spectroscopy and CHNS elemental analysis. Banana peels, an abundant agriculture waste, were thermochemically treated and analyzed to evaluate their potential as a carbon rich material for energy and material applications. Raman Spectroscopy was used to assess the structural evolution of carbon, particularly focusing on the D and G bands, which reflect disorder and graphitic characteristics, respectively. The intensity ratio (I_D/I_G) revealed a progressive transformation of amorphous carbon to more ordered structures with increasing carbonization temperature. Complementarily, CHNS analysis quantified the elemental composition of carbon (C), hydrogen (H), nitrogen (N), and sulfur (S). The correlation between structural by Raman Spectroscopy and compositional analysis by CHNS data underscores the potential of banana peel biomass as a sustainable precursor activated carbon, or carbon-based nanomaterials. This integrative research provides a better knowledge of biomass carbonisation routes and promotes the value-added use of agricultural waste.

Keywords: Agriculture waste; Banana peels; Activated carbon; Sustainable