SYNTHESIS AND CHARACTERISATION OF CONDUCTIVE POLYANILINE BASED BIOCOMPOSITES FOR SENSOR APPLICATIONS

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Abstract

Conductive polymer composites offer innovative solutions for real-time food quality monitoring by enabling direct interaction with spoilage indicators. In this study, polyaniline (PANI) doped with trifluoromethanesulfonic acid (TFMS) was synthesized via oxidative polymerization and incorporated into biopolymer matrices—polylactide (PLA) and polyurethane (PU)—to develop conductive sensing materials. Composites were prepared with PANI loadings of 10%, 20%, 25%, and 30% by weight of the biopolymer to investigate the effect of filler content on electrical and thermal properties. The chemical structure of PANI and its composites was confirmed through Fourier-transform infrared spectroscopy (FTIR), while conductivity was evaluated via the four-point probe method. Thermal stability was assessed using thermogravimetric analysis (TGA), revealing that the incorporation of PANI significantly improved the degradation resistance of the biopolymer matrices. Conductivity testing demonstrated that a minimum PANI content of 20 wt% was required to achieve conductive properties in both matrices, while further increases in PANI concentration leading to enhanced electrical performance. By selecting the appropriate polymer matrix and optimizing PANI content, conductive composites with tailored electrical and thermal, properties can be designed to meet specific application needs. The developed composites exhibited a tunable response to food spoilage gases, undergoing a distinct colorimetric transition from green to blue due to redox state shifts in PANI induced by exposure to gases like NO_2. This real-time sensing mechanism, combined with the biodegradable nature of PLA and PU, offers a sustainable and effective strategy for intelligent food packaging. The results highlight the potential of PANI-based biocomposites as multifunctional materials that enhance food safety, extend shelf life, and contribute to reducing food waste in perishable goods.

Keywords: *conductive composites, polyaniline, intelligent food packaging, polymeric sensors*

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