Engineering a Greener Future: A Novel, Biodegradable, Self-Powered, Chitosan-Based Food Packaging Material

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Since the discovery of synthetic petroleum-based plastics, humanity has increased its production exponentially at the cost of our planet's health. This traditional plastic takes millions of years to degrade and pollutes our Earth during every step of production, causing a global climate crisis. With an increasingly burdensome amount of plastic waste generated each year combined with the industry's unsustainable practices, an alternative and environmentally-friendly material is crucial. This research created a sustainable food packaging system by exploring the versatile applications of chitosan, a biodegradable polymer derived from crustacean shells and fungal cell walls. The researchers used mushroom-derived chitosan with graphene oxide nanofiller and conducted five tests to analyze and compare the quality of this material: loss tangent/permittivity, biodegradability, mechanical properties, film thickness, and shelf life. Results demonstrated the efficacy of the chitosan-based packaging, exhibiting a dielectric constant of 4.75, a tensile strength of 50.36 MPa, biodegradation within 28 days, and extended shelf life—outperforming conventional plastics. Furthermore, a self-powered humidity sensor, correlating color changes with relative humidity, was integrated into the packaging to monitor moisture levels, providing a sustainable method for assessing food contamination risk without electronic waste or energy consumption. By integrating the two applications - the chitosan packaging and humidity sensor-, an innovative and intelligent food packaging system was created that offers a sustainable alternative to traditional plastics, alleviating the amount of plastic waste generated each year, increasing the shelf life of produce, and guaranteeing a greener future for all.

Awards Won:

National Security Agency Research Directorate : First Place Award “Material Science”