Investigation of Soybean Oil-Hexagonal Boron Nitride Composites for Sustainable Packaging

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This study investigates the environmental impact of petroleum-based plastics, which have created a demand for sustainable polymer alternatives. This study investigates the development of a bio-feasible polymer system for food packaging applications, synthesized from Acrylated Epoxidized Soybean Oil (AESO) and hexagonal boron nitride nanosheets (h-BN). It evaluates its thermal, structural, and permeation properties. AESO was selected as the main resource for its renewable origin, low toxicity, and reactive acrylate groups that facilitate crosslinking. AESO, Pentaerythritol tetracrylate (PETTA), a tetrafunctional acrylate crosslinker, and 2,2-dimethoxy-2-phenylacetophenone (DMPA) photoinitiator were photopolymerized to form films for analysis. PETTA was loaded into AESO formulations at 5, 20, 30, and 40 wt%. Thermogravimetric Analysis (TGA) of the base films did not imply a significant difference in thermal stability as PETTA loading increased. Tensile modulus of the polymer films was 85, 56, 97, and 121 megapascals (MPa), respectively, while the strain at break for the same systems was 26, 27, 23, and 21%, respectively. From initial experiments, the best balance of mechanical performance was demonstrated with 5% PETTA loading. h-BN nanosheets were introduced into a down-selected formulation to enhance mechanical and gas-permeation properties. h-BN is loaded into the optimal base formulation at 5%, 10%, 15%, and 20%. Thermal, mechanical, and gas transport properties of the acrylate-hBN composites will be determined in future studies.

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