

Abstract

Effects of Long Exposure to Dielectric Barrier Discharge on Films of Commercial Blends of Poly(Butylene Adipate-co-Terephthalate) (PBAT) and Thermoplastic Starch (TPS) [†]

Karen Dayana Gutiérrez Silva , Sergi González Zaragoza, Oscar Gil Castell  and Jose David Badia Valiente 

Research Group in Materials Technology and Sustainability (MATS), Department of Chemical Engineering, School of Engineering, University of Valencia, 46010 Valencia, Spain; karen.gutierrez@uv.es (K.D.G.S.); sergonza@alumni.uv.es (S.G.Z.)

* Correspondence: oscar.gil@uv.es (O.G.C.); jose.badia@uv.es (J.D.B.V.)

[†] Presented at the 3rd International Online Conference on Polymer Science, 19–21 November 2025; Available online: <https://sciforum.net/event/IOCPS2025>.

Keywords: PBAT/TPS blends; abiotic degradation; non-thermal plasma; dielectric barrier discharge; surface etching

1. Introduction

The rising demand for biodegradable materials has driven the development of biopolymers such as PBAT/TPS blends, making it essential to assess their stability and performance in different environments. Physical treatments such as non-thermal plasma (NTP) may generate reactive oxygen species (ROS) and induce accelerated surface and bulk modifications. This work aims to evaluate the consequences induced by NTP dielectric barrier discharge (DBD) on commercial films of PBAT-TPS.

2. Methods

Commercial PBAT/TPS films were exposed to non-thermal plasma generated by means of dielectric barrier discharge (NTP-DBD) by an Eltech Engineers Lab Corona Treater (Dahisar, Mumbai, India). The system operates in air atmosphere using a generator with a nominal power of up to 500 W, a frequency of 30 kHz, and an output current of 1.9 A. Films of 100 μm thickness were exposed to irradiation power from 10 to 60 min.

Analytical characterisation included colorimetry determined with a StellarNet colourimeter (Tampa, FL, USA), attenuated total reflectance Fourier-transform infrared spectroscopy (FTIR-ATR) performed on an Agilent Technologies Cary 630 FTIR Spectrometer (Santa Clara, CA, USA), field-emission scanning electron microscopy (FE-SEM) using a Hitachi S-4800 (Tokyo, Japan); and calorimetric analysis by differential scanning calorimetry (DSC) with a Setaram Setline+ DSC (Caluire-et-Cuire, France) to analyse both the bulk and surface modifications.

3. Results and Discussion

Abiotic degradation induced by NTP-DBD provoked significant variations observed in colorimetry results, particularly an increase in yellowing with treatment duration. The chemical structure analyses revealed a progressive reduction in the absorbance bands at 1268 cm^{-1} and 1709 cm^{-1} , corresponding to C–O and C=O stretching vibrations of ester groups in PBAT, indicating ester bond degradation. A decrease in the melting endotherm associated with butylene terephthalate (BT) segments, along with a shift in the melting



Academic Editor: Valentina Siracusa

Published: 17 November 2025

Copyright: © 2025 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

transition to butylene adipate (BA) phase, was observed with increasing exposure time. Finally, surface electron micrographs demonstrated surface etching after 30 and 60 min of plasma treatment, attributed to the interaction between ROS and the polymer surface.

4. Conclusions

NTP-DBD was demonstrated to promote relevant abiotic degradation of PBAT-TPS-based commercial films, with notable modifications not only at the macroscopic level but also at the molecular scale.

Author Contributions: K.D.G.S.: investigation, data curation, writing—original draft; S.G.Z.: formal analysis, investigation, data curation, visualization; O.G.C.: conceptualization, methodology, writing—review and editing, supervision, project administration; J.D.B.V.: resources, conceptualization, methodology, writing—review and editing, supervision, project administration, funding acquisition. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Agència Valenciana de la Innovació (AVI), grant number INNEST/2022/295 (BIOFAST—Methodological strategies for the accelerated biodegradation of bioplastics in compost).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Dataset available on request from the authors.

Acknowledgments: Prime Biopolymers and the Institute of Technology of Plastics (AIMPLAS) are acknowledged for providing and processing the raw materials, respectively. Also, the authors acknowledge the technical support from Central Services for Experimental Research (SCSIE) and the Institute of Material Science (ICMUV) of the Universitat de València.

Conflicts of Interest: The authors declare no conflicts of interest.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.