

Editorial

Development of Bio-Based Materials: Synthesis, Characterization and Applications

Clara Delgado-Sánchez, Adrián Tenorio-Alfonso, Esperanza Cortés-Triviño, Antonio M. Borrero-López * and Concepción Valencia

Pro²TecS-Chemical Product and Process Technology Research Centre, Universidad de Huelva, 21071 Huelva, Spain

* Correspondence: am.borrero@diq.uhu.es

Citation: Delgado-Sánchez, C.; Tenorio-Alfonso, A.; Cortés-Triviño, E.; Borrero-López, A.M.; Valencia, C. Development of Bio-Based Materials: Synthesis, Characterization and Applications. *Polymers* **2022**, *14*, 3599. <https://doi.org/10.3390/polym14173599>

Received: 27 August 2022

Accepted: 29 August 2022

Published: 31 August 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 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) license (<https://creativecommons.org/licenses/by/4.0/>).

The need to find suitable biomaterials and procedures from alternative products able to imitate or even enhance the performance of currently used products has become an important focus of research today due to the depletion of non-renewable resources and the increasing concern related to climate change, sustainability and environmental preservation. Thus, this book gathers different original articles and review manuscripts concerning the Special Issue “**Development of Bio-Based Materials: Synthesis, Characterization and Applications**”. The development of partial or fully bio-based materials has been included, with excellent outcomes in many different applications, as well as alternative procedures that can reduce the carbon footprint or optimize both production and energy consumption.

Given the interest in these materials, this book, including 27 articles and reviews written by research experts in their topics of interest, reports the most recent research on bio-based materials, with emphasis on the pharmaceutical and medical fields but covering a very extensive range of applications. Several novel and fascinating methods and studies related to thermo-responsive photopolymers (Figure 1A), biopolymer encapsulations, biopolymer-based films (Figure 1B), natural fibres production, biocompatible adhesives (Figure 1C), green composites (Figure 1D) and many other different materials have been introduced. The aim of this Special Issue, and now this book, is to provide a clear picture of the latest frontiers reached in the biomaterials field and their latest applications such as 3D bioprinting inks, immobilization of enzymes (Figure 1E), lubricating greases, elastomers and adhesives (Figure 1F), in which bio-based materials show great potential.

Emphasis on the biomaterial itself, the protocol followed, characterization and/or application have been reported, therefore contributing to a greener picture through the formulation of different more environmentally friendly products, but also to an understanding of the composition and structure of those systems, as well as applications thereof.

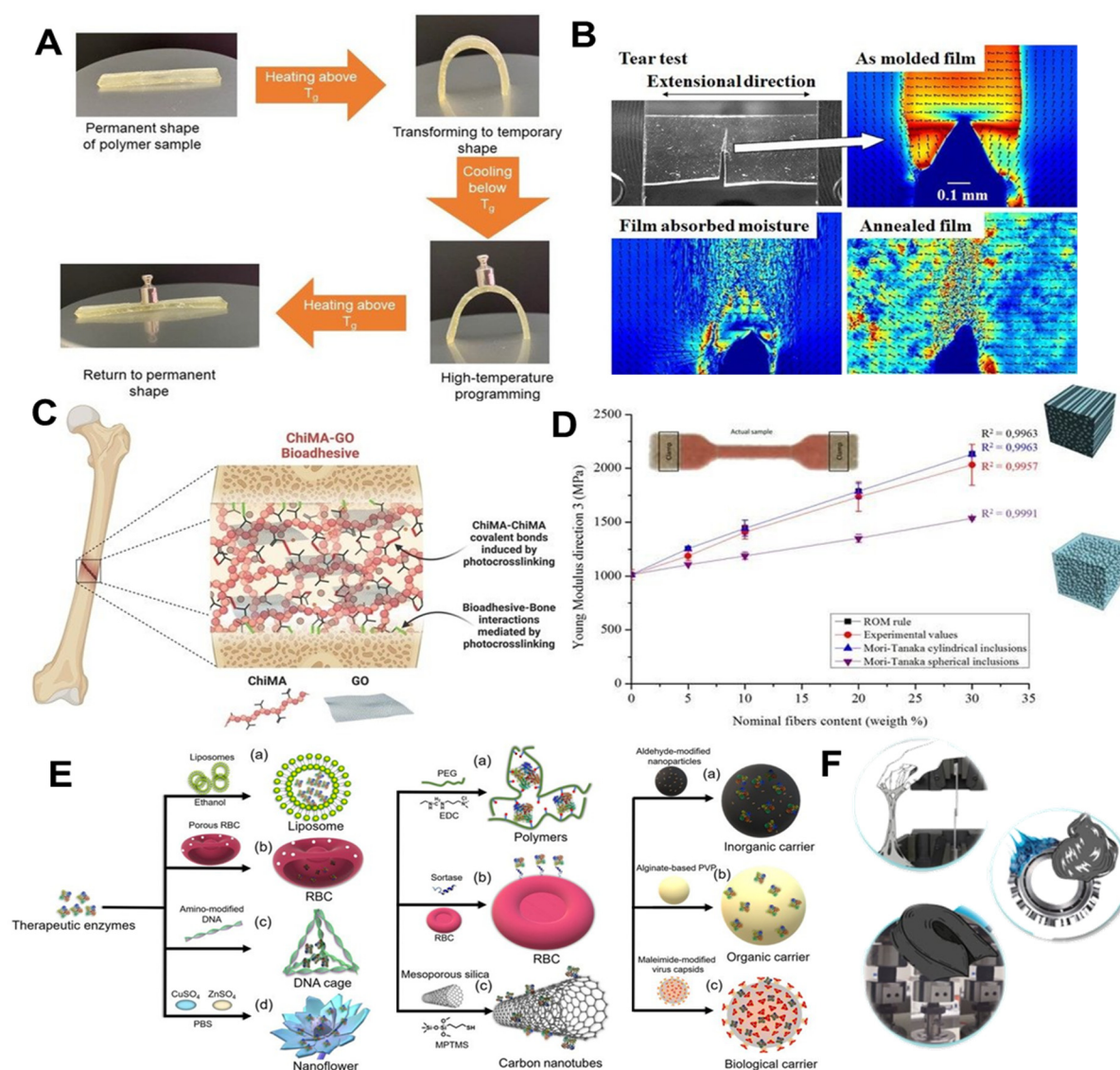


Figure 1. (A) Scheme of shape-memory characteristics of the bio-based polymers developed by Jaras et al. [1]. (B) Images of the in situ retardation measurements at the tip of the tear for the poly(lactic acid)-based film developed in Yutaka et al. [2]. (C) Schematic overview of the bioadhesive formulation and application in Céspedes-Valenzuela et al. [3]. (D) Overview of the tensile properties of the green composites developed by Lemaire et al. [4]. (E) Different therapeutic enzymes studied in Zhu et al. [5]. (F) Adhesives, lubricating greases and elastomers as biomaterials studied in Borrero-López et al. [6].

Funding: This research received no external funding.

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

Short Biography of Authors

Clara Delgado-Sánchez received her MSc in Chemical Engineering in 2013 and her Master in Product Formulation and Technology in 2014, both at the University of Huelva. Afterwards, she received her PhD degree from the University of Lorraine (France) in 2017. During her thesis, she focused her research on the development of “New methods of optimization and characterization of tannin foams for thermal insulation of buildings” in the research group Biosourced Materials of the Institut Jean Lamour (IJL—UMR CNRS 7198). After her PhD, she has been a postdoc at the Chemical Process and Product Research Centre (Pro2Tec) at the University of Huelva, working on the project “Study of thermo-advanced dispersions for heat transport applications”, a multidisciplinary project that led

not only to her participation in the research and working groups of five other projects related to the same topic on a national and regional competitive basis and several publications but also to her obtaining a postdoctoral fellowship that she currently enjoys. Currently, her line of research focuses on novel phase-change materials to obtain thermal-energy-storage systems as alternatives for efficient energy use and conservation. Moreover, in November 2020, she was awarded her first project as the principal researcher: “Valorisation of phosphogypsums in the development of foamed bitumen”, financed by the “Cátedra de la Provincia” (University of Huelva). The results of her research effort carried out between 2015 and 2022 were recorded in the publication of 22 articles in international journals and several contributions to national and international congresses.

Adrián Tenorio-Alfonso. After graduating from Chemical Engineering in 2013 and upon the completion of Master’s in *Product Formulation and Design with Applications in the Chemical, Food and Pharmaceutical Industry* in 2014, both at the University of Huelva, he started his research activity with a final research project on the *Thermo-rheological characterization of foams and adhesives based on polyurethanes and biopolyurethanes*. Afterwards, he was given a national grant for a PhD contract “*Ayuda a la Formación de Profesorado Universitario (FPU13/01114)*” by el Ministerio de Educación, Cultura y Deporte, carrying out his PhD thesis entitled *Development of polyurethane formulations based on cellulose acetate and castor oil*, affiliated with the Doctoral Programme in Industrial and Environmental Science and Technology at the Chemical Process and Product Technology Research Centre (Pro²TecS) from the University of Huelva. He has been a member of several national and regional research projects (MINECO CTQ2014-56038-C3-1-R and TIC 1499 funded by El Ministerio de Economía y Competitividad and La Conserjería de Innovación, Ciencia y Empresa de la Junta de Andalucía, respectively). Additionally, he has taken part in a research project for the development of synthetic ice rinks in collaboration with the Xtraice Rinks company. More recently, he has participated in a research project to study thermorheologically advanced suspensions for heat transport applications (CTQ2017-89792-R). In relation to this, he has been awarded a postdoctoral fellowship in the development of novel phase change materials, currently working on the research project “*Development of phase change oil-in-oil emulsions with enhanced rheological, heat storage and heat transfer properties*” at the Pro²TecS research centre. As a result of his research experience, he has published nine research articles in international journals with high impact factors, accounting for more than 25 contributions to national and international congresses.

Esperanza Cortés-Triviño graduated from Industrial Technical engineering with a specialty in Industrial Chemistry in 2012 and became licensed in Chemical Engineering in 2014 at the University of Huelva. She completed her official Master’s in Chemical Engineering in 2016, where she started her research career working with bioplastics based on wheat gluten. Meanwhile, she was hired by the University of Huelva as a researcher to conduct several tasks within the MINECO CTQ2014-56038-C3-1-R project funded by “Ministerio de Economía y Competitividad”, also obtaining a grant from “Junta de Andalucía” and accomplishing a Doctoral Thesis in the Industrial and Environmental Science and Technology program (CyTIA), associated with the project TEP-1499, which is related to the development of new thickening agents of vegetable oil from different lignocellulosic fractions chemically modified. She obtained her PhD degree in 2019 with a Cum Laude Mention, unanimously, which was complemented by a stay at the University of Applied Sciences of Hamburg to obtain International Mention. Her Doctoral Thesis was awarded the best 2019 Doctoral Thesis in the branch of Engineering of the University of Huelva and received an honourable mention at the Iberian Meeting on Rheology 2019 (IBEREO 2019). Her research career has been completed by attending multiple conferences and by collaborating in some of their management activities. She also participated in other transfer activities such as “Café con Ciencia” and the European Researcher’s Night and in more than 500 h of specialized training. She is a member of The Complex Fluid Engineering Research Group (TEP-185) and The Research Center of Chemical Product and Process Technology (Pro²TecS), as well as The Spanish Rheology Group (GER) belonging to the Spanish Royal

Society of Chemistry (RSEQ). Currently, she is working as a postdoctoral researcher at the University of Huelva within an international project for the Procter & Gamble Company. As a result of her research experience, she has published nine research articles in international journals with high impact factors, accounting with more than 25 contributions to national and international congresses.

Antonio María Borrero-López completed a degree in Chemical Engineering at the University of Huelva (Spain) in 2013 and later obtained a Master's degree in Product Formulation and Design from the International University of Andalusia (Spain). Afterwards, he received his PhD degree from the University of Huelva, with a thesis entitled "*Development of new lignocellulosic-based thickening agents for biodegradable oleogel formulations with several industrial applications*". This thesis has been awarded the Best 2021–2022 Doctoral Thesis in the branch of Engineering and Architecture of the University of Huelva and received an honourable mention at the Annual European Rheology Conference 2022 (AERC 2022). After his PhD, he has been working as a postdoc at the Institut Jean Lamour, University of Lorraine (France), where new greener approaches for the performance of bio-based materials are being targeted. He has participated in a total of eight research projects, including the European Project UCGWATERplus, which aims to remediate waters polluted with organic and inorganic contaminants by the formulation of different products via the valorisation of the residues from underground coal gasification and other processes. As a result of his research, he has published a total of 22 articles and contributed to more than 30 international and national congresses.

Concepción Valencia Barragán received her PhD degree from the University of Extremadura. She is a Full Professor at the University of Huelva. She has carried out extensive research activity for more than 23 years, mainly focused on Chemical Product Engineering, specifically concerning the rheology of complex materials, the processing of non-Newtonian fluids, lubricants, adhesives and coatings, polymers and biopolymers, food colloids and emulsion technologies. In total, she has participated in more than 30 research projects with public funding, obtained in competitive calls, with some of them as a lead researcher and more than 40 contracts with private sector companies. Her main scientific and technical achievements have been focused on the modification of the rheological properties of lubricating greases by means of reactive and recycled polymeric additives as well as on the development of biodegradable oleogels capable of replacing traditional lubricating greases formulated from non-renewable resources. As a result of this research activity, she is the author of more than 118 papers in peer-reviewed journals and the inventor of six patents. She has also presented more than 130 communications at national and international scientific conferences.

References

1. Jaras, J.; Navaruckiene, A.; Skliutas, E.; Jersovaite, J.; Malinauskas, M.; Ostrauskaite, J. Thermo-Responsive Shape Memory Vanillin-Based Photopolymers for Microtransfer Molding. *Polymers* **2022**, *14*, 2460. <https://doi.org/10.3390/polym14122460>.
2. Kobayashi, Y.; Ishigami, A.; Ito, H. Relating Amorphous Structure to the Tear Strength of Polylactic Acid Films. *Polymers* **2022**, *14*, 1965. <https://doi.org/10.3390/polym14101965>.
3. Céspedes-Valenzuela, D.N.; Sánchez-Rentería, S.; Cifuentes, J.; Gantiva-Díaz, M.; Serna, J.A.; Reyes, L.H.; Ostos, C.; Cifuentes-De la Portilla, C.; Muñoz-Camargo, C.; Cruz, J.C. Preparation and Characterization of an Injectable and Photo-Responsive Chitosan Methacrylate/Graphene Oxide Hydrogel: Potential Applications in Bone Tissue Adhesion and Repair. *Polymers* **2022**, *14*, 126. <https://doi.org/10.3390/polym14010126>.
4. Lemaire, T.; Rodi, E.G.; Langlois, V.; Renard, E.; Sansalone, V. Study of Mechanical Properties of PHBHV/Miscanthus Green Composites Using Combined Experimental and Micromechanical Approaches. *Polymers* **2021**, *13*, 2650. <https://doi.org/10.3390/polym13162650>.
5. Zhu, C.-Y.; Li, F.-L.; Zhang, Y.-W.; Gupta, R.K.; Patel, S.K.S.; Lee, J.-K. Recent Strategies for the Immobilization of Therapeutic Enzymes. *Polymers* **2022**, *14*, 1409. <https://doi.org/10.3390/polym14071409>.
6. Borrero-López, A.M.; Valencia, C.; Franco, J.M. Lignocellulosic Materials for the Production of Biofuels, Biochemicals and Biomaterials and Applications of Lignocellulose-Based Polyurethanes: A Review. *Polymers* **2022**, *14*, 881. <https://doi.org/10.3390/polym14050881>.