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PACKAGING SCIENCE

E' la Rassegna Scientifica Internazionale della ***Fondazione Carta Etica del Packaging.***

Pubblicazione bimestrale in cui sono presentati 7 articoli multidisciplinari, afferenti al packaging, selezionati da diverse riviste del mondo scientifico digitale.

Packaging Science attraverso le tematiche sempre attuali ed aggiornate dei suoi articoli in diverse discipline, concorre ampiamente alla promozione e all'evoluzione della corretta cultura del packaging e dei ***10 Valori della Carta Etica*** *per accompagnare il packaging verso un futuro più consapevole.*

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Quantificazione delle composizioni monomeriche di poli(3-idrossibutirrato-co-3-idrossivalerato) e poli(3-idrossivalerato) mediante idrolisi alcalina e mediante cromatografia liquida ad alta pressione

Con il crescente interesse per le bioplastiche, vi è l'urgente necessità di sviluppare metodi di analisi rapidi legati allo sviluppo della tecnologia di produzione. Questo studio si è concentrato sulla produzione di un omopolimero non disponibile in commercio, poli (3-idrossivalerato) (P (3HV)), e un copolimero disponibile in commercio, poli (3-idrossibutirrato-co-3-idrossivalerato) (P (3HB-co-3HV), attraverso la fermentazione utilizzando due diversi ceppi batterici.
I batteri Chromobacterium violaceum e Bacillus sp. CYR1 sono stati utilizzati per produrre rispettivamente P(3HV) e P(3HB-co-3HV).

bioengineering

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Article

Quantification of the Monomer Compositions of Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly(3-hydroxyvalerate) by Alkaline Hydrolysis and Using High-Pressure Liquid Chromatography

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Abstract: With the growing interest in bioplastics, there is an urgent need to develop rapid analysis methods linked to production technology development. This study focused on the production of a commercially non-available homopolymer, poly(3-hydroxyvalerate) (P(3HV)), and a commercially available copolymer, poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (P(3HB-*co*-3HV)), through fermentation using two different bacterial strains. The bacteria *Chromobacterium violaceum* and *Bacillus* sp. CYR1 were used to produce P(3HV) and P(3HB-*co*-3HV), respectively. The bacterium *Bacillus* sp. CYR1 produced 415 mg/L of P(3HB-*co*-3HV) when incubated with acetic acid and valeric acid as the carbon sources, whereas the bacterium *C. violaceum* produced 0.198 g of P(3HV)/g dry biomass when incubated with sodium valerate as the carbon source. Additionally, we developed a fast, simple, and inexpensive method to quantify P(3HV) and P(3HB-*co*-3HV) using high-performance liquid chromatography (HPLC). As the alkaline decomposition of P(3HB-*co*-3HV) releases 2-butenoic acid (2BE) and 2-pentenoic acid (2PE), we were able to determine the concentration using HPLC. Moreover, calibration curves were prepared using standard 2BE and 2PE, along with sample 2BE and 2PE produced by the alkaline decomposition of poly(3-hydroxybutyrate) and P(3HV), respectively. Finally, the HPLC results obtained by our new method were compared using gas chromatography

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Imballaggio alimentare sostenibile e bio-based: una rassegna sulle innovazioni progettuali passate e attuali

La perdita e lo spreco di cibo si verificano per molte ragioni, dalla lavorazione delle colture agli avanzi domestici. Anche se una certa produzione di rifiuti è inevitabile, una quantità considerevole è dovuta alle inefficienze della catena di approvvigionamento e ai danni durante il trasporto e la movimentazione. Il design del packaging e le innovazioni dei materiali rappresentano reali opportunità per ridurre gli sprechi alimentari all'interno della catena di approvvigionamento. Inoltre, i cambiamenti negli stili di vita delle persone hanno aumentato la domanda di prodotti alimentari di alta qualità, freschi, minimamente trasformati e pronti al consumo con una shelf-life prolungata, che devono soddisfare normative di sicurezza alimentare rigorose e costantemente rinnovate.

foods

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Review

Sustainable and Bio-Based Food Packaging: A Review on Past and Current Design Innovations

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Abstract: Food loss and waste occur for many reasons, from crop processing to household leftovers. Even though some waste generation is unavoidable, a considerable amount is due to supply chain inefficiencies and damage during transport and handling. Packaging design and materials innovations represent real opportunities to reduce food waste within the supply chain. Besides, changes in people's lifestyles have increased the demand for high-quality, fresh, minimally processed, and ready-to-eat food products with extended shelf-life, that need to meet strict and constantly renewed food safety regulations. In this regard, accurate monitoring of food quality and spoilage is necessary to diminish both health hazards and food waste. Thus, this work provides an overview of the most recent advances in the investigation and development of food packaging materials and design with the aim to improve food chain sustainability. Enhanced barrier and surface properties as well as active materials for food conservation are reviewed. Likewise, the function, importance, current availability, and future trends of intelligent and smart packaging systems are presented, especially considering biobased sensor development by 3D printing technology. In addition, driving factors affecting fully biobased packaging design and materials development and production are discussed, considering byproducts and waste minimization and revalorization, recyclability, biodegradability, and other possible ends-of-life and their impact on product/package system sustainability.

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Citation: Versino, F.; Ortega, F.; Monroy, Y.; Rivero, S.; López, O.V.; García, M.A. Sustainable and Bio-Based Food Packaging: A Review

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Un percorso per una riduzione dell'inquinamento da micro e nanoplastiche

Le microplastiche (MP) sono particelle di plastica di dimensioni inferiori a 5 mm. Ci sono due categorie di MP: primarie e secondarie. MP primari o microscopici sono materiale prodotto intenzionalmente. La frammentazione di grandi detriti plastici attraverso processi fisici, chimici e ossidativi crea MP secondari, il tipo più abbondante nell'ambiente. L'inquinamento da microplastiche è diventato un problema ambientale globale a causa della loro abbondanza, scarsa biodegradabilità, proprietà tossicologiche e impatto negativo sugli organismi acquatici e terrestri, compresi gli esseri umani. I detriti di plastica entrano nell'ambiente acquatico attraverso lo scarico diretto o fonti terrestri incontrollate. Mentre i detriti di plastica si degradano lentamente in MP, le acque reflue e le uscite delle acque piovane scaricano una grande quantità di MP direttamente nei corpi idrici.

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Article

A Path to a Reduction in Micro and Nanoplastics Pollution

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Abstract Microplastics (MP) are plastic particles less than 5 mm in size. There are two categories of MP: primary and secondary. Primary or microscopic-sized MP are intentionally produced material. Fragmentation of large plastic debris through physical, chemical, and oxidative processes creates secondary MP, the most abundant type in the environment. Microplastic pollution has become a global environmental problem due to their abundance, poor biodegradability, toxicological properties, and negative impact on aquatic and terrestrial organisms including humans. Plastic debris enters the aquatic environment via direct dumping or uncontrolled land-based sources. While plastic debris slowly degrades into MP, wastewater and stormwater outlets discharge a large amount of MP directly into water bodies. Additionally, stormwater carries MP from sources such as tire wear, artificial turf, fertilizers, and land-applied biosolids. To protect the environment and human health, the entry of MP into the environment must be reduced or eliminated. Source control is one of the best methods available. The existing and growing abundance of MP in the environment requires the use of multiple strategies to combat pollution. These strategies include reducing the usage, public outreach to eliminate littering, reevaluation and use of new wastewater treatment and sludge disposal methods, regulations on macro and MP sources, and a wide implementation of appropriate stormwater management practices such as filtration, bioretention, and wetlands.

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Valutazione del microbiota di mele appena tagliate confezionate in due film diversi

Lo scopo di questo lavoro era valutare il microbiota naturale delle mele fresche confezionate durante la conservazione refrigerata. Per la confezione sono stati testati due diversi film, un film biodegradabile (PLA) e uno convenzionale e commerciale (OPP). Sono stati applicati due additivi antiossidanti, un estratto naturale di sansa di oliva e l'acido ascorbico commerciale utilizzato dalle industrie. I risultati hanno rivelato conteggi batterici più bassi nei campioni con estratto di sansa di oliva e film di PLA rispetto a quelli con acido ascorbico e film OPP dopo 5 e 12 giorni di conservazione. Questi risultati suggeriscono che l'uso di tali estratti naturali come additivi nei frutti potrebbe ritardare la crescita dei batteri mesofili.

microorganisms

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Article

Microbiota Assessment of Fresh-Cut Apples Packaged in Two Different Films

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Abstract: The aim of this work was to assess the natural microbiota of packed fresh-cut apples during refrigerated storage. Two different films were tested for the package, a biodegradable (PLA) film and a conventional and commercial one (OPP). Two antioxidant additives were applied, a natural olive pomace extract and the commercial ascorbic acid used by the industries. The results revealed lower bacteria counts in samples with olive pomace extract and PLA films than in those with ascorbic acid and OPP films after 5 and 12 days of storage. These findings suggest that the use of such natural extracts as additives in fruits could delay the growth of mesophilic bacteria. The characterization and identification of the bacterial isolates from fresh-cut apple samples showed that the most

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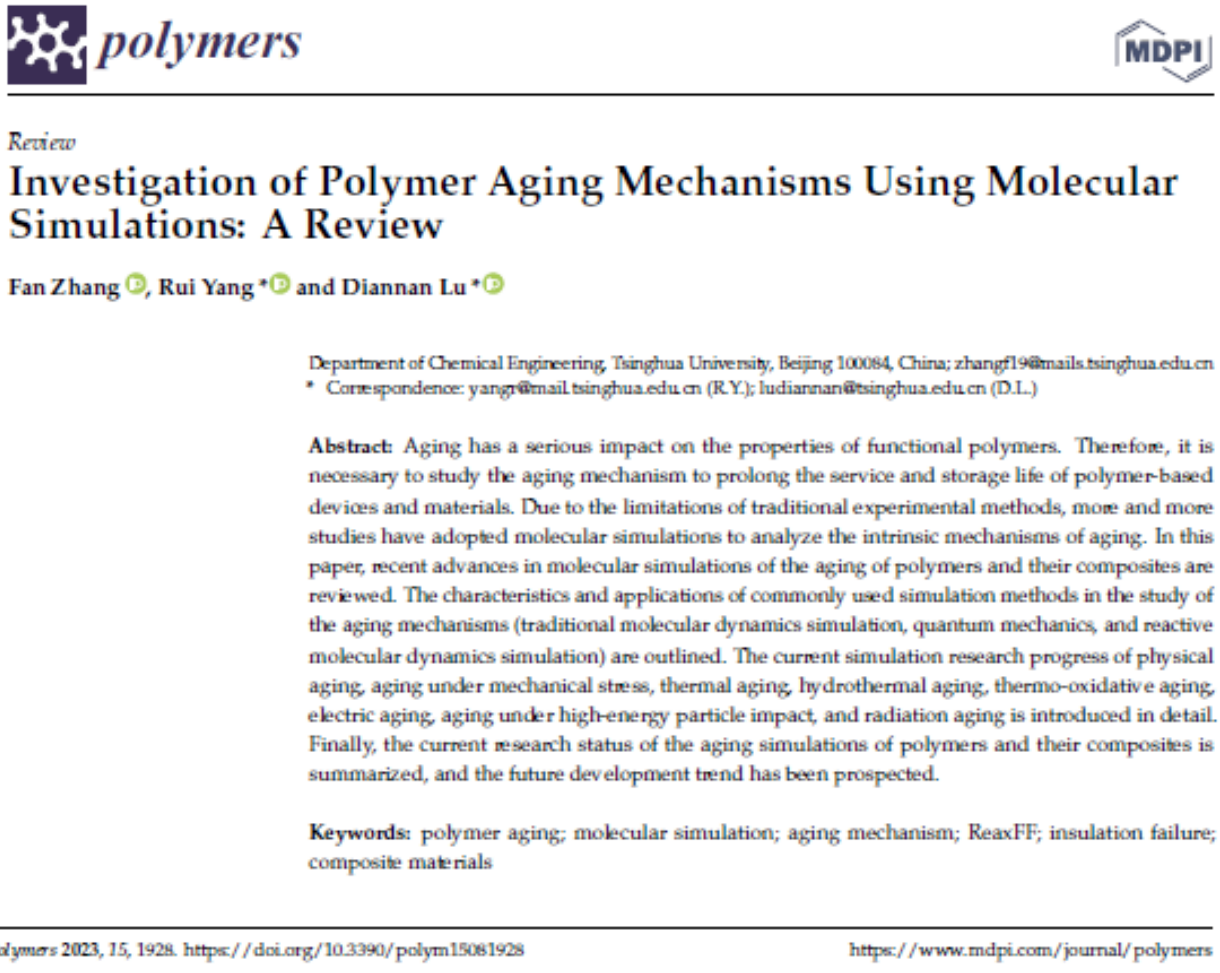
Studio dei meccanismi di invecchiamento dei polimeri utilizzando simulazioni molecolari: una revisione

L'invecchiamento ha un grave impatto sulle proprietà dei polimeri funzionali. Pertanto, è necessario studiare il meccanismo di invecchiamento per prolungare la durata di servizio e conservazione di dispositivi e materiali a base di polimeri. A causa dei limiti dei metodi sperimentali tradizionali, sempre più studi hanno adottato simulazioni molecolari per analizzare i meccanismi intrinseci dell'invecchiamento. In questo articolo, vengono esaminati i recenti progressi nelle simulazioni molecolari dell'invecchiamento dei polimeri e dei loro compositi. Vengono delineate le caratteristiche e le applicazioni dei metodi di simulazione comunemente utilizzati nello studio dei meccanismi di invecchiamento (simulazione della dinamica molecolare tradizionale, meccanica quantistica e simulazione della dinamica molecolare reattiva).



polymers

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Review

Investigation of Polymer Aging Mechanisms Using Molecular Simulations: A Review

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Abstract: Aging has a serious impact on the properties of functional polymers. Therefore, it is necessary to study the aging mechanism to prolong the service and storage life of polymer-based devices and materials. Due to the limitations of traditional experimental methods, more and more studies have adopted molecular simulations to analyze the intrinsic mechanisms of aging. In this paper, recent advances in molecular simulations of the aging of polymers and their composites are reviewed. The characteristics and applications of commonly used simulation methods in the study of the aging mechanisms (traditional molecular dynamics simulation, quantum mechanics, and reactive molecular dynamics simulation) are outlined. The current simulation research progress of physical aging, aging under mechanical stress, thermal aging, hydrothermal aging, thermo-oxidative aging, electric aging, aging under high-energy particle impact, and radiation aging is introduced in detail. Finally, the current research status of the aging simulations of polymers and their composites is summarized, and the future development trend has been prospected.

Keywords: polymer aging; molecular simulation; aging mechanism; ReaxFF; insulation failure; composite materials

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Simulazione della dinamica dissipativa delle particelle e studio sperimentale microscopico delle prestazioni di emulsificazione di tensioattivi/polimeri

I polimeri possono aumentare la viscosità dell'acqua, ridurre la permeabilità relativa della fase acquosa e migliorare la fluidità della fase oleosa; I tensioattivi possono formare film molecolari ai confini dell'interfaccia olio-acqua, riducendo così la tensione interfacciale. La tecnologia di inondazione di tensioattivi/polimeri (S/P) per migliorare il recupero del petrolio è diventata un modo importante per aumentare la produzione di petrolio greggio. Questo studio ha utilizzato la tecnologia della dinamica dissipativa delle particelle (DPD) per simulare il processo di emulsificazione di un sistema composito a quattro componenti costituito da olio, acqua, sodio dodecilbenzene solfonato (SDBS) e poliacrilammide parzialmente idrolizzato (HPAM).

processes

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Article

Dissipative Particle Dynamics Simulation and Microscopic Experimental Study of Emulsification Performance of Surfactant/Polymer Flooding

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Abstract: Polymers can increase the viscosity of water, reduce the relative permeability of the water phase, and enhance the flowability of the oil phase; surfactants can form molecular films at the oil–water interface boundaries, thereby reducing interfacial tension. Surfactant/polymer (S/P) flooding technology for enhancing oil recovery has become a major way to increase crude oil production. This study used dissipative particle dynamics (DPD) technology to simulate the emulsification process of a four-component composite system consisting of oil, water, sodium dodecylbenzene sulfonate (SDBS), and partially hydrolyzed polyacrylamide (HPAM). By changing the concentration of the S/P system, the effect on emulsification behavior was analyzed. Combined with particle distribution diagrams and interfacial tension parameters, the effect of the emulsification behavior on the performance of the S/P binary system was analyzed. On this basis, the effect of different emulsion performances on the recovery factor was evaluated using micro-experiments. The study found that the S/P system that produced stable emulsification had a lower interfacial tension and relatively good effect on improving the recovery factor. Increasing the concentration of the polymer and surfactant may cause changes in the interfacial film of the emulsion, thereby affecting the ability of the S/P system to reduce interfacial tension and may not improve the oil recovery factor. The research results help to better analyze and screen the S/P system used for oil extraction and improve crude oil recovery.

Keywords: emulsification; microscopic experimental; dissipative particle dynamics; solubility parameter; interfacial tension

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Riciclo dei rifiuti di imballaggio in polistirene post-consumo in nuove applicazioni di imballaggio alimentare - Parte 2: Barriere funzionali coestruse

Il polistirene post-consumo (PS) riciclato dietro una barriera funzionale di polimero PS vergine è un modo interessante per introdurre i riciclati PS post-consumo nei materiali di imballaggio. Tuttavia, fino ad ora, non sono state pubblicate linee guida ufficiali su come testare le prestazioni di una barriera funzionale. Inoltre, le autorità competenti non hanno pubblicato limiti di soglia per la valutazione dei materiali riciclati post-consumo dietro gli FB. Questo è uno svantaggio nella valutazione della conformità alla legislazione alimentare e nella notifica delle nuove tecnologie dei riciclati post-consumo dietro una barriera funzionale. In questo studio, sono state studiate tazze di yogurt coestruse con uno strato centrale artificialmente appuntito rispetto alla migrazione dei surrogati applicati. Il metodo di test cinetico di migrazione applicato nella fase gassosa si è dimostrato sensibile e adatto per la valutazione delle prestazioni della barriera funzionale.

recycling

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Article

Recycling of Post-Consumer Polystyrene Packaging Waste into New Food Packaging Applications—Part 2: Co-Extruded Functional Barriers

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Abstract: Post-consumer polystyrene (PS) recyclates behind a functional barrier of virgin PS polymer is an attractive way to introduce post-consumer PS recyclates in packaging materials. However, until now, there has been no official guidance published on how to test the performance of a functional barrier. In addition, no threshold limits for the evaluation of post-consumer recyclates behind FBs have been published by competent authorities. This is a drawback in the food law compliance evaluation and novel technology notification of post-consumer recyclates behind a functional barrier. In this study, co-extruded yogurt cups with an artificially spiked core layer were investigated with respect to migration of the applied surrogates. The applied migration kinetic testing method into the gas phase was shown to be sensitive and suitable for the evaluation of the functional barrier performance. For consumer safety evaluation, two worst-case scenarios were used. As a result, due to the high processing temperatures used during co-extrusion, the virgin PS functional barrier layer was partly contaminated with the surrogates from the core layer. However, on the basis of the conditions, data, and the evaluation presented, the use of post-consumer recycled PS behind an FB of virgin PS can be considered as safe.

Keywords: high impact polystyrene; migration; functional barrier; yogurt cups; exposure evaluation

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