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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.*

Nanocompositi con diversi tipi di nanofiller e proprietà avanzate per diverse applicazioni

I nanocompositi polimerici sono un campo tecnologico emergente che offre materiali ad alte prestazioni con proprietà uniche e innovative, ideali per numerose applicazioni avanzate. Questi includono, tra gli altri, applicazioni automobilistiche e aerospaziali ad alta efficienza, imballaggi alimentari, agricoltura, elettronica stampata, applicazioni biomediche, somministrazione di farmaci, biotecnologia, trattamento delle acque reflue, protezione ambientale, sistemi avanzati di stoccaggio dell'energia e dispositivi elettronici, barriere gas/liquidi, serbatoi di carburante, sensori, riduzione dell'inflammabilità, resistenza chimica, rivestimenti protettivi UV, attrezzature sportive, beni di consumo, ecc.



applied nano



Editorial

Nanocomposites with Different Types of Nanofillers and Advanced Properties for Several Applications

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Polymer nanocomposites are an emerging technological field offering high-performance materials with unique and innovative properties, ideal for numerous advanced applications [1]. These include, among others, high-efficiency automotive and aerospace applications, food packaging, agriculture, printed electronics, biomedical applications, drug delivery, biotechnology, wastewater treatment, environmental protection, advanced energy-storage systems and electronic devices, gas/liquid barriers, fuel tanks, sensors, flammability reduction, chemical resistance, UV protective coatings, sports equipment, consumer goods, etc. [2–7]. The final properties of nanocomposites as well as their suitable applications directly depend on the polymer matrix used, the size and shape of the nanofillers, their functional groups, their amounts, their dispersion into the polymer matrix, and interfacial interactions [8]. The most effective properties are usually achieved when nanoscale fillers are added in small amounts, ranging from 0.5 up to 5 wt%. The individual properties of the nanofillers are also a crucial factor controlling the performance of the nanocomposites (improved mechanical strength, toughness, thermal stability, thermal conductivity, electrical properties, etc.) [9,10]. Some of these interesting applications of nanocomposites and their contribution to the enhancement of several polymer properties have been reported in the articles published in this Special Issue, along with descriptions of some new methods for nanocomposite production.



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Armonia nella conservazione

Negli ultimi decenni, anche il discorso sulla conservazione è diventato sempre più antropocentrico. In effetti, la giustificazione per la conservazione della natura si è in parte spostata dal valore intrinseco della natura ai "servizi ecosistemici" a beneficio delle persone. Sosteniamo che il programma "Armonia con la natura" delle Nazioni Unite è un percorso innovativo per il cambiamento. Se vogliamo raggiungere l'armonia con la natura, la moderna società industriale dovrà abbandonare la sua mentalità antropocentrica di "supremazia umana" e adottare una visione del mondo ecocentrica e un'etica ecologica.



conservation



Review

Harmony in Conservation

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Abstract: Many authors have noted the role that anthropocentrism has played in creating humanity's dysfunctional relationship with the natural world. As human hubris (excessive pride or self-confidence) is an ailment that contributes to the anthropogenic sixth mass extinction of Earth's biodiversity, we argue instead for 'harmony with nature'. In recent decades, even the conservation discourse has become increasingly anthropocentric. Indeed, justification for nature conservation has in part shifted from nature's intrinsic value to 'ecosystem services' for the benefit of people. Here we call for a transformation to a more harmonious human-nature relationship that is grounded in mutual respect and principled responsibility, instead of utilitarianism and enlightened self-interest. Far from what Tennyson called 'red in tooth and claw', we argue nature is a mixture of cooperation as well as competition. We argue that the UN's 'Harmony with Nature' program is an innovative and refreshing path for change. If we are to achieve harmony with nature, modern industrial society will need to abandon its anthropocentric 'human supremacy' mindset and adopt an ecocentric worldview and ecological ethics. We conclude it is thus both appropriate (and essential) for conservationists to champion harmony with nature.

Keywords: harmony; hubris; ecocentrism; anthropocentrism; conservation; impact of theory; cooperation; indigenous harmony; ecotopia of harmony



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Parametro non affine o di slittamento non costante nella modellazione costitutiva della reologia polimerica

Dalla sua introduzione alla fine degli anni 1970, il parametro non affine o di slittamento, ξ , è stato abitualmente impiegato da numerosi modelli costitutivi come parametro costante. Tuttavia, le prove sembrano implicare che dovrebbe essere una funzione della deformazione del polimero. Nel presente lavoro, modifichiamo fenomenologicamente un modello costitutivo per la reologia dei polimeri fusi non aggrovigliati [P. S. Stephanou et al. J. Rheol. 53, 309 (2009)] per tenere conto di un parametro di slittamento non costante. I dati del tensore di conformazione sono molto ben previsti; tuttavia, si nota che le previsioni delle funzioni materiali si discostano dai dati NEMD, specialmente a grandi velocità di taglio.



Article

On The Use of a Non-Constant Non-Affine or Slip Parameter in Polymer Rheology Constitutive Modeling

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Abstract: Since its introduction in the late 1970s, the non-affine or slip parameter, ξ , has been routinely employed by numerous constitutive models as a constant parameter. However, the evidence seems to imply that it should be a function of polymer deformation. In the present work, we phenomenologically modify a constitutive model for the rheology of unentangled polymer melts [P. S. Stephanou et al. J. Rheol. 53, 309 (2009)] to account for a non-constant slip parameter. The revised model predictions are compared against newly accumulated rheological data for a C₄₈ polyethylene melt obtained via direct non-equilibrium molecular dynamics simulations in shear. We find that the conformation tensor data are very well predicted; however, the predictions of the material functions are noted to deviate from the NEMD data, especially at large shear rates.

Keywords: unentangled systems; constitutive modeling; materials functions; non-affine parameter; slip parameter; conformation tensor; NEMD simulations; atomistic simulations; polyethylene

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Il potere di mercato nel contesto della globalizzazione

Il potere di mercato è un concetto multidisciplinare, che riunisce aspetti del diritto e dell'economia, che sono necessari per essere compresi per valutare situazioni di mercato con una dimensione globale. La globalizzazione è un fenomeno economico e sociale che si accompagna a un maggiore potere di mercato per gli attori globali. I fattori che influenzano o limitano il potere di mercato, come la responsabilità sociale delle imprese, sono importanti da comprendere per valutare le situazioni di potere di mercato. Secondo il diritto dell'Unione europea, il concetto di potere di mercato si riflette nell'abuso di posizione dominante, che è un comportamento anticoncorrenziale vietato nel mercato comune dell'UE, come definito nell'articolo 102 del trattato sul funzionamento dell'UE. Un approccio interdisciplinare basato su elementi di diritto ed economia è quindi necessario quando si valuta il potere di mercato degli attori globali.



Entry

Market Power in the Context of Globalization

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Definition: Market power is a multidisciplinary concept, bringing together aspects from law and economics, which are necessary to be understood in order to assess market situations with a global dimension. Globalization is an economic and social phenomenon which comes together with enhanced market power for global actors. Factors influencing or limiting market power, such as corporate social responsibility, are important to understand in order to assess market power situations. According to European Union Law, the concept of market power is reflected in abuse of dominance, which is an anti-competitive behavior prohibited in the Common Market of the EU, as defined in Article—102 of the Treaty on the Functioning of the EU. An interdisciplinary approach based on elements of law and economics is thus necessary when assessing market power of global actors.

Keywords: market power; globalization; oligopoly; moral hazard; indicators for market power; corporate social responsibility; abuse of market power

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Un sensore termico a base di polimeri con impronta molecolare per il rilevamento selettivo della melamina nei campioni di latte

Negli ultimi anni, le tecnologie di rilevamento della melamina hanno guadagnato sempre più attenzione, principalmente a causa dell'uso improprio della molecola come adulterante nel latte e in altri alimenti. I polimeri a impronta molecolare (MIP) sono candidati ideali per il riconoscimento della melamina in campioni reali. Le particelle MIP preparate sono state incorporate in uno strato termicamente conduttivo tramite deposizione a micro-contatto e la sua risposta verso la melamina è stata analizzata utilizzando il metodo di trasferimento del calore (HTM). Poiché il limite legale UE/USA di melamina nel latte di 2,5 mg/kg rientra nell'intervallo lineare del sensore, può offrire una soluzione innovativa per lo screening di routine dei campioni di latte al fine di rilevare l'adulterazione con melamina.



Article

A Molecularly Imprinted Polymer-Based Thermal Sensor for the Selective Detection of Melamine in Milk Samples

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Abstract: In recent years, melamine-sensing technologies have increasingly gained attention, mainly due to the misuse of the molecule as an adulterant in milk and other foods. Molecularly imprinted polymers (MIPs) are ideal candidates for the recognition of melamine in real-life samples. The prepared MIP particles were incorporated into a thermally conductive layer via micro-contact deposition and its response towards melamine was analyzed using the heat-transfer method (HTM). The sensor displayed an excellent selectivity when analyzing the thermal response to other chemicals commonly found in foods, and its applicability in food safety was demonstrated after evaluation in untreated milk samples, demonstrating a limit of detection of 6.02 μM . As the EU/US melamine legal limit in milk of 2.5 mg/kg falls within the linear range of the sensor, it can offer an innovative solution for routine screening of milk samples in order to detect adulteration with melamine. The results shown in this work thus demonstrate the great potential of a low-cost thermal platform for the detection of food adulteration in complex matrices.

Keywords: melamine; molecularly imprinted polymers (MIPs); milk; heat-transfer method (HTM); food adulteration testing; low-cost melamine detection



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Miglioramento delle proprietà barriera della carta all'umidità, all'aria e al grasso con sospensioni di rivestimento a base di nanocellulosa

I produttori di imballaggi alimentari spesso ricorrono alla laminazione, tipicamente con materiali che non sono né polimeri biodegradabili né biobased, per conferire proprietà barriera a carta e cartone. Il presente lavoro considera una soluzione più ecologica: migliorare la resistenza della carta all'umidità, al grasso e all'aria mediante sospensioni di rivestimento acquoso. Per l'idrofobizzazione, è stato preso in considerazione un approccio combinato tra nanocellulosa e agenti esterificanti comuni, ma la velocità di trasmissione del vapore acqueo (WVTR) è rimasta eccessivamente elevata per l'obiettivo di avvolgere prodotti sensibili all'umidità ($>600 \text{ g m}^{-2} \text{ d}^{-1}$).



nanomaterials



Article

Improving the Barrier Properties of Paper to Moisture, Air, and Grease with Nanocellulose-Based Coating Suspensions

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Abstract: Food packaging manufacturers often resort to lamination, typically with materials which are neither non-biodegradable nor biobased polymers, to confer barrier properties to paper and cardboard. The present work considers a greener solution: enhancing paper's resistance to moisture, grease, and air by aqueous coating suspensions. For hydrophobization, a combined approach between nanocellulose and common esterifying agents was considered, but the water vapor transmission rate (WVTR) remained excessively high for the goal of wrapping moisture-sensitive products ($>600 \text{ g m}^{-2} \text{ d}^{-1}$). Nonetheless, oil-repellant surfaces were effectively obtained with nanocellulose, illite, sodium alginate, and/or poly(vinyl alcohol) (PVA), reaching Kit ratings up to 11. Regarding air resistance, mineral-rich coatings attained values above 1000 Gurley s. In light of these results, nanocellulose, minerals, PVA, pullulan, alginate, and a non-ionic surfactant were combined for multi-purpose coating formulations. It is hypothesized that these materials decrease porosity while complementing each other's flaws, e.g., PVA succeeds at decreasing porosity but has low dimensional stability. As an example, a suspension mostly constituted by nanocellulose, sizing agents, minerals and PVA yielded a WVTR of roughly $100 \text{ g m}^{-2} \text{ d}^{-1}$, a Kit rating of 12, and an air resistance above 300 s/100 mL. This indicates that multi-purpose coatings can be satisfactorily incorporated into paper structures for food packaging applications, although not as the food contact layer.

Keywords: air resistance; alginate; barrier properties; Kit rating; minerals; nanocellulose; packaging paper; poly(vinyl alcohol); pullulan; water vapor transmission rate



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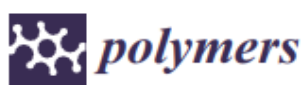
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Recenti progressi nelle miscele e nei compositi a base di amido per applicazioni di bioplastiche

L'inquinamento ambientale da polimeri sintetici è un problema globale e lo studio di sostituti per i polimeri sintetici è un'importante area di ricerca. L'amido può essere utilizzato nella formulazione di materiali bioplastici, principalmente come miscele o compositi con altri polimeri. I principali svantaggi dell'utilizzo dell'amido in tali applicazioni sono la sensibilità all'acqua e le scarse proprietà meccaniche. Sono stati fatti tentativi per migliorare le proprietà meccaniche delle miscele e dei compositi a base di amido, ad esempio modificando o plastificando l'amido, rinforzando la matrice e miscelando polimeri. La miscelazione dei polimeri può portare benefici sinergici a miscele e compositi, ma devono essere prese le precauzioni necessarie per garantire la compatibilità dei polimeri idrofobici e dell'amido idrofilo.



Review

Recent Advances in Starch-Based Blends and Composites for Bioplastics Applications

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Abstract: Environmental pollution by synthetic polymers is a global problem and investigating substitutes for synthetic polymers is a major research area. Starch can be used in formulating bioplastic materials, mainly as blends or composites with other polymers. The major drawbacks of using starch in such applications are water sensitivity and poor mechanical properties. Attempts have been made to improve the mechanical properties of starch-based blends and composites, by e.g., starch modification or plasticization, matrix reinforcement, and polymer blending. Polymer blending can bring synergetic benefits to blends and composites, but necessary precautions must be taken to ensure the compatibility of hydrophobic polymers and hydrophilic starch. Genetic engineering offers new possibilities to modify starch *in planta* in a manner favorable for bioplastics applications, while the incorporation of antibacterial and/or antioxidant agents into starch-based food packaging materials brings additional advantages. In conclusion, starch is a promising material for bioplastic production, with great potential for further improvements. This review summarizes the recent advances in starch-based blends and composites and highlights the potential strategies for overcoming the major drawbacks of using starch in bioplastics applications.



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Keywords: starch; bioplastics; plasticizer; filler; thermoplastic; polymer; blend; composite

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