



Food packaging based on polymer nanomaterials

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ABSTRACT

Since its starting in the 19th century, modern food packaging has made great advances as results of global trends and consumer preferences. These advances are oriented to obtain improved food quality and safety. Moreover, with the move toward globalization, food packaging requires also longer shelf life, along with the monitoring of safety and quality based upon international standards. Nanotechnology can address all these requirements and extend and implement the principal packaging functions – containment, protection and preservation, marketing and communications. Applications of polymer nanotechnology in fact can provide new food packaging materials with improved mechanical, barrier and antimicrobial properties, together with nano-sensors for tracing and monitoring the condition of food during transport and storage.

The latest innovations in food packaging, using *improved, active and smart nanotechnology* will be analyzed. It will be also discuss the limits to the development of the new polymer nanomaterials that have the potential to completely transform the food packaging industry.

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1. Introduction

Polymer nanotechnology is a broad interdisciplinary area of research, development and industrial activity that involves the design, manufacture, processing and application of polymer materials filled with particles and/or devices that have one or more dimensions of the order of 100 nanometers (nm) or less [1–4]. The extraordinary potential of this novel technology to provide enabling routes for development of high-performance materials has attracted the attention of researchers, from physics, chemistry, biology to engineering.

Over the last decades, the use of polymers as food packaging materials has increased enormously due to their advantages over other traditional materials [5,6]. In the polymer global market that has increased from some 5 million tonnes in the 1950s to nearly 100 million tonnes today, the 42% is covered by packaging (Fig. 1), with the packaging industry itself worth about 2% of Gross National Product in developed countries (Applied Market Information Ltd., 2007). Polymer packaging provides many properties including strength and stiffness, barrier to oxygen and moisture, resistance to food component attack and flexibility.

Novel and efficient polymer materials for food packaging based on nanotechnology can provide innovative

solutions to increase the performance of the polymers further adding safety, economical and environmental advantages, such as reduction to zero of any critical interaction with food matrices and with human health, reduction of the energy-inputs for production, transport and storage, increase of biodegradability and barrier protection to gases and light, reduction of volume of waste material to be disposed of in landfills, contribution to decrease CO₂ emissions [7–16].

Although the large amount of researches being undertaken in industry and academia, polymer nanotechnology for food packaging is still in a development stage. The envisaged direction is to look at the complete life cycle of the packaging (raw material selection, production, analysis of interaction with food, use and disposal) integrating and balancing cost, performance, health and environmental considerations (Fig. 2). Successful technical development of polymer nanomaterials for food packaging (PNFP) has to overcome barriers in safety, technology, regulation, standardisation, trained workforce and technology transfer in order that commercial products can benefit from the global market potential and requires therefore a high degree of multidisciplinary. Moreover, because of its enormous growth application potential, the emerging technology of PNFP will be a major provider of new employment opportunities, based upon growing international commercial success combined with ecological advantages.

This paper provides an overview of the latest innovations in food packaging based on polymer nanomaterials. It begins with a brief history of food packaging, an introductory description of the properties of the polymer and their use in the food packaging. The article then describes the current state of research and development regarding polymer nanotechnologies within the food packaging section. Finally, the article discusses the barriers to the development of the new nano-sized components focusing on the balance between benefits and hazards on health and environment, the current regulatory framework, the public engagement, the consumer perception and the future perspectives.

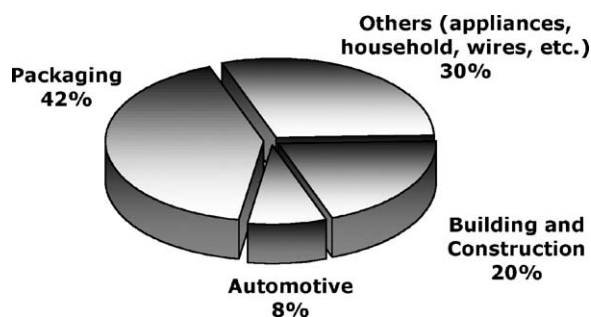


Fig. 1. Polymer global market.

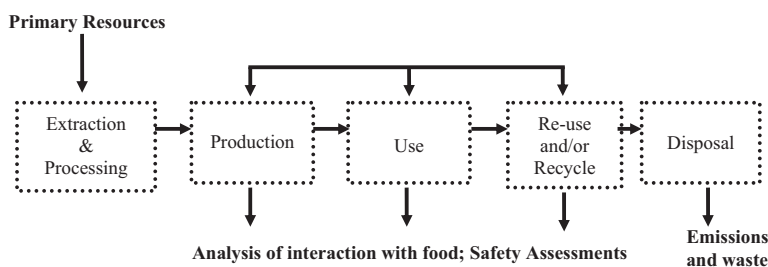


Fig. 2. Complete life cycle of the packaging.

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