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Bionanocomposites based on natural polymers and clays minerals as bioplastics materials

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Packaging films, containers, and coatings made of natural polymers such as polysaccharides (cellulose derivatives, starch, alginate…) and proteins (collagen, gelatin, soybean protein, casein, and zein) are receiving considerable attention due to their low cost, high biocompatibility, and biodegradability, giving rise to the so-called bio-packaging materials or bioplastics. The bionanocomposites term is widely used to describe biohybrid materials composed of species of natural origin, mainly biopolymers, and inorganic solids of diverse structure and morphology assembled at the nanometric scale. Bionanocomposites of particular relevance are that the inorganic component is a silicate belonging to the clay minerals family. Natural smectites such as montmorillonite are most largely employed to prepare clay-based nanocomposites. Recently, the involvement of clays showing non-lamellar structural arrangement such as sepiolite and palygorskite fibrous clays, become attractive as alternative nanofillers with an increasing use in the preparation of new bionanocomposites. The resulting bionanocomposites based on clays minerals not only exhibit improved mechanical properties, but also a significant barrier to ultraviolet light and to the passage of water, reducing the water vapor permeability (WVP), which make them very attractive for use in food packaging or coatings. Moreover, these films also offer interesting results for the retention of heavy metals such as copper, chromium and lead, which together with the biocompatibility and biodegradability afforded by the biopolymer may enlarge the scope of applications as bioplastics, for instance in the agricultural sector.

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Biopolymers and biomaterials: Challenges for translating into products

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An important super hydrophilic attribute consisting in biopolymers that was modified to create smart biomaterials and devices in developing product/technology for medical applications will feature in this presentation. I shall highlight and discuss a novel reconstituted process in creating functional biopolymers that we have considered potential biomaterials for developing devices for medical applications. During the research and development stage, it was demonstrated that the functional biopolymers are exhibited as smart biomaterials and the fabricated devices showed remarkable performance toward above mentioned applications. However, there are major challenges when translating this into real products/technology. In this presentation, I shall try to highlight a number of specific devices that were developed by my research team, and the challenges that we encountered during this translation process. Critical challenges in designing and/or developing devices associated with cost and end-user applications will also be emphasized.

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