Nanoparticles made from the self-assembly of Carbohydrate Block Copolymers

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Abstract

Current knowledge in modern molecular science allows for the preparation of a myriad of tailored nanomaterials, which play important and multifaceted roles in nanoscience and technology. Among the bottom-up strategies, self-assembly is an incredibly powerful concept in macromolecular engineering that offers an invaluable tool for the preparation of 2D and 3D discrete nanostructures, ranging from materials science to molecular biology, which are often not accessible by any other fabrication process. Using self-assembly as a synthetic tool, powerful chemistry and physico-chemistry protocols can be developed that are capable of organizing organic and inorganic building-blocks into unprecedented structures and patterns, over several length scales to create novel and innovative materials. In this context and during the last decades, block copolymers (BCP) systems have received considerable attention as a promising platform for preparing nanometer-scale structures and materials due to their self-assembling nature into periodic domains whether in solution (nanoparticles) or solid states. To date, numerous studies have been focused on the self-assembly of petroleum-based BCPs for potential applications in multidisciplinary fields, such as nanoparticles for drug delivery, or nano-organized films for biosensors, or nanolithography, etc. Such materials are derived from fossil resources that are being rapidly depleted and have negative environmental impacts. In contrast, carbohydrates are abundant, renewable and constitute a sustainable source of materials. This is currently attracting much interest in various sectors and their industrial applications at the nanoscale level will have to expand quickly in response to the transition to a bio-based economy. The self-assembly of carbohydrate BCP systems at the nanoscale level via the bottom-up approach, has allowed the conception of nanostructured nanoparticles (micelles, vesicles,…) whose external shell is made from carbohydrates. We will present recent results on the self-assemblies of carbohydrate-based block copolymer leading to nanoparticles presenting different shapes (spherical, cubic, …)

Indeed, to date, varied studies are centered on the self-assembly of petroleum-based BCPs for potential applications in multidisciplinary fields, like nanoparticles for drug delivery, or nano-organized films for biosensors, or nanolithography, etc. Such materials area unit derived from fossil resources that area unit being chop-chop depleted and have negative environmental impacts. In distinction, carbohydrates area unit torrential, renewable and represent a property supply of materials. Such materials (bio-sourced block polymer systems) are obtained victimization "click" chemistry consisting of linking oligo/polysaccharide to a different block (synthetic or natural). Those bio-based systems area unit presently attracting a lot of interest in numerous sectors and their industrial applications at the nanoscale level can need to expand quickly in response to the transition to a bio-based economy.

R. Borsali et al[3]-[6] have recently created a crucial breakthrough by victimization carbohydrate-based block polymer and have achieved the very best resolution ever reached so far (5 nm features)-(see illustrations on Figures one and 2). we are going to during this paper gift new and up to date results on the self-assemblies of oligosaccharide-based block polymer (synthetic block-Maltoheptaose, wherever artificial block stands for phenylethylene or Polyisoprene) resulting in extremely nanostructured skinny films (sub-10nm resolution).

Conclusion

This new category of supermolecule based-block polymer systems result in nano-organized skinny films (resolution sub_10nm) that would open the horizon to varied applications in versatile opto-electronics, biosensors, electrical phenomenon cells and new generation of nanolithography. The authors acknowledge the CNRS, Greenanofilms project (Seventh Framework Program underneath grant agreement n° 603519), Institut physicist Polynat and Labex esoteric for money supports.

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