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Editorial

Special Issue "Functionalities of Polymer-Based Nanocomposite Films and Coatings"

Ni Yang

Department of Mechanical and Aerospace Engineering, NC State University, Raleigh, NC 27607, USA; nyang4@ncsu.edu

Polymer-based coatings are the thin film of polymer applied to any type of flat or irregular surfaces (e.g., metal, ceramic, and synthetic materials). Polymer-based coatings have gained significant attention as they are tailored to offer various functionalities, such as thermal, chemical, and corrosion resistance, as well as the great potential in biomedical devices. For example, the polymer film can be used to seal the surface to resist corrosion and ion escape [1]. Thus, a range of polymers [2–5], such as epoxy, polyurethane, polypropylene, polytetrafluoroethylene, acrylics, biopolymers, and so on, are widely considered versatile materials in different fields. Due to their protective and decorative nature, coatings of polymers and polymeric nanocomposites also play a vital role in areas of aerospace, marine structure, and outdoor parts, as the high-performance and superdurable films are practically used without photodegradation.

More details about polymeric coating in technical applications will be discussed in the following area: recharge batteries, corrosion protection, and packaging. In the experimental work by Hu et al. [6], the classical tungsten trioxide electrochromic thin film was synthesized from Triblock copolymer pluronic P123 (poly(ethylene glycol)-block-poly(propylene glycol)-block-poly(ethylene glycol) via the sol–gel route. The formation of the resultant thin film was obtained by spray coating. The novel processing established by Hu et al. opens new avenues in material science to provide insights into improving the stability of electrodes in acidic aqueous electrolytes. This work creates the first benchmarking achievement to enhance the performance of rechargeable batteries in harsh conditions, which have been considered the most powerful batteries with high energy density in our daily life (such as electric vehicles, electric scooters and e-bikes, and so on). Also, this work tackles pressing issue from limited durability of electrochromic devices (such as electrochromic smart windows) during long-term electrochemical cycling, and speeds up their market penetration.

We have everyday encounters with different forms of corrosion. As a result, recently, a lot of works have been working on the design and development of organic coatings for corrosion protection. A review [7] on conducting polymer coatings for corrosion protection revealed that thin and conducting polymer films attached to the surface of metal provide a barrier effect between the substrate and its environment. In other words, the metal surface coated with electron-conducting polymer places the electrode potential in the passive region, in the absence of any redox reaction. The technology derived from polymer coatings has been proved to be a useful solution and provided excellent corrosion protection of metals.

Packaging materials are also one of the most important applications, especially focusing on antimicrobial packaging in our modern life. In general, active antimicrobial packaging can be understood as actively controlling the internal environment by continuously destroying a wide range of microorganisms with the food over the stipulated shelf-life. It has been reported that numerous polymers [8] such as low-density polyethylene, chitosan, Nisin, and methyl cellulose have been used as antimicrobial packaging materials nowadays. Kim et al. [9] prepared novel nisin-incorporated polymer coatings,

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and significant suppression of total aerobic bacteria and yeasts was observed to show its outstanding ability in microbial suppression.

There has always been a lot of attention to polymer coating methods. Until now, various coating processes have been successfully produced on the surfaces. What follows is a summary of names [10]: spin coating, dip coating, doctor blading, solution casting, extrusion/dispersion coating, spray coating, gravure coating, printing techniques, etc. Several methodologies have been investigated and developed for the thickness with a diameter of a few mm to nm range. The advantages of simple fabrication, low cost, and high-volume efficiency are continuing to be utilized and represent an optimal choice to obtain high-quality and high-performance films.

It is well-known that polymeric coatings are made up of polymers (natural or synthetic) and resins, and the coatings can be easily attached to substrates of metal, ceramic, and synthetic materials. Polymer coating processing techniques range from simple dip to spin coating technologies. For example, the spin coating proposed by D. W. Schubert [11] was using solutions of polystyrene dissolved in toluene. The spinning velocity and solution concentration determine the thickness of the residual film. The findings in this paper show an acceptable coating method for attaining polymer coating over a wide range of thicknesses.

Noticeable applications and processing technologies of polymer-based nanocomposite films and coatings have been discussed comprehensively in the recent literature. Selections of polymer types, a coating method, and experimental parameters play a significant role in the microstructure and functionalities of polymer coatings. More work is still in progress on the future development of coating fabrication techniques and suitable polymers.

This Specific Issue mainly includes but is not limited to some aspects, such as (1) theoretical and experimental research, knowledge, and new ideas in polymer-based nanocomposite films and coatings; (2) preparation and characterization of nanocomposite films; (3) the recent development of the functionalities of nanocomposite films; (4) computer modeling and simulation to predict coating properties; (5) understanding the degradation mechanisms of coatings; and (6) recent trends in thin-film synthesis techniques. This Specific Issue focuses on providing state-of-the-art knowledge on polymeric nanocomposite coatings, which will be useful for expanding the existing technologies into novel technological applications in the future.

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