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Plasma aided surface modification of low-density polyethylene films to impart antibacterial property

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With regards to the expanding usage of polymers in various medical and foods applications, modification of the properties of this class of materials in order to be capable of resisting against pathogenic microorganisms such as bacteria is extremely important. Low-density Polyethylene as a suitable candidate for manufacturing medical devices and food packages is highly vulnerable to adhesion and growth of pathogenic bacterial strains due to its inappropriate surface properties. In this project, low-density polyethylene thin films were surface-modified by plasma and then active monomers such as allylamine, allyl alcohol and hydroxyethyl methacrylate were graft polymerized onto its surface from vapor state to form functional brush. Finally, antibacterial agents of two different categories, polysaccharide (alginic acid) and fluoroquinolones (ciprofloxacin, ofloxacin, norfloxacin) were immobilized onto this brush layer to impart antibacterial activity. The modified polymer film was characterized using contact angle analysis, scanning electron microscopy, X-ray photoelectron spectroscopy, Fourier Transform infrared spectroscopy, and agar diffusion zone assay. To study the influence of the bacterial strain on the biologic performance of the modified films, two known bacterial strains of gram negative and gram positive were employed. The results showed that hydroxyethyl methacrylate was the best brush forming monomer for immobilization of alginic acid where the highest concentration of alginic acid was bonded to the surface. Plasma treatment led to enhanced hydrophilicity as well as roughness of the polymer film. The same observations were also obtained after brush formation by allylamine, allyl alcohol, and hydroxyethyl methacrylate. However, they were unable to inhibit the bacterial growth. As for fluoroquinolones, norfloxacin was the antibiotic with the highest activity against bacterial growth which was ascribed to its high affinity with allylamine brush which resulted in the highest amount of immobilized antibiotic. In comparison with alginic acid, three tested fluoroquinolones were more active against bacterial growth. In addition, gram negative strain was more susceptible to the used antibacterial agents most probably due to the different cell wall structure compared to gram positive.

Biography

Elika Karbassiyazdi was born in Iran, Tehran, in 1989. She received her BSc degree in polymer engineering in 2011 from the Chemistry Department of the Islamic Azad University in Tehran. She was graduated as MSc from Isfahan University of Technology, Department of Chemical Engineering in Polymer Engineering discipline in 2015. She did her MSc thesis under supervision of Dr. Ahmad Asadinezhad on Plasma-aided surface modification of low-density Polyethylene Films to impart antibacterial property. She is currently employed in a private company working on polymers in Tehran.

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