Abstract

Photo-chemical reactions and surface modifications of poly(ethylene terephthalate) 100% (PET) fabrics with active monomer dimethylaminopropyl methacrylamide (DMAPMA) and benzophenone (BP) as photo-initiator using a broad-band UV lamp source were investigated. The quaternization reactions were initially optimized for homo PDMAPMA, prior to reaction on the PET grafted PDMAPMA chains. The quaternization reaction of homo PDMAPMA was confirmed by one and two dimensional NMR spectroscopy (1D and 2D ^{1}HNMR), and attenuated total reflection- Fourier transform infrared spectroscopy (ATR-FTIR) The molecular weights (M_n and M_w) and molecular weight distributions (M_w/M_n; poly dispersity index, PDI) of homo PDMAPMA and quaternized homo PDMAPMA with $C_8H_{17}Br$ (C_8) were analyzed by gel permeation chromatograph (GPC). The tertiary amino groups of the grafted polyDMAPMA chains on the surface of PET fabrics were subsequently quaternized with alkyl bromides of different chain lengths to establish antibacterial activity. The surface composition, structure and morphology of modified PET fabrics were characterized by ATR-FTIR spectroscopy, X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM). To evaluate the amount of quaternary and tertiary ammonium groups on the modified surface, PET was dyed with an acid dye (Telon Red AFG) which binds to the ammonium groups. Therefore, the color depth is a direct indicator of the amount of ammonium groups. The amount of positive charges on the surface PET was measured by polyelectrolyte titration and the nitrogen content of the PET-g-PDMAPMA and quaternized PET-g-PDMAPMA was determined. The resulting antibacterial activity of the modified PET fabrics was tested with *Escherichia coli.* The results of all experiments show that a photochemical modification of PET is possible using DMAPMA, benzophenone and UV light. Also, the quaternization of tertiary amino groups as well as the increase of antibacterial activity of the modified PET by the established quaternary ammonium groups were successful.

Silver nanoparticles (NPs) were prepared by a simple and inexpensive single step synthesis based on UV activation of mixture solution of silver nitrate and poly(methacrylic acid) which acts as stabilizer agent at pH 8. Transmission electron microscopy (TEM) and dynamic light scattering (DLS) were used to prove the occurrence of nanoparticles and the size distribution of the Ag nanoparticle was measured. The UV-VIS spectroscopy revealed the formation of silver NPs by exciting

the typical surface plasmon absorption from the UV–Vis spectrum. The mechanism of formation of those silver nanoparticles was also discussed. The streaming potential versus pH curve was negative. Ag NPs colloid was stable at pH values more than 6 (sufficient negative charge is present). The isoelectric point has been observed at pH values of 3.5 - 4. Silver NPs colloid showed high antimicrobial and bactericidal activity against bacteria such as *Micrococcus luteus* (*M. luteus*) and *Escherichia coli (E. coli).*

Deposition of silver NPs on the fabrics made from polyester 100% (PET) and polyamide-6 100% (PA) surface was studied by the exhaustion method using a dyeing machine at temperature 80°C. In order to enhance wettability, the fabrics were plasma pre-treated in air. Energy dispersive X-ray spectroscopy (EDX) confirmed presence of elemental silver on the surface of PET fibers, and silver NPs were well dispersed on the surface as indicated by SEM. The amount of silver particles loaded on the PET and PA 6 samples before and after laundering was determined using inductively coupled plasma optical emission spectrometry (ICP-OES). Additionally, the antibacterial activity of the modified fabrics was measured by quantitative and qualitative methods. After the deposition of silver nanoparticles, the fabrics showed high antimicrobial and bactericidal activity with regard to *M. luteus* and *E. coli*. The samples which had been pre-treated by plasma exhibited antibacterial efficacy of the impregnated fabrics with Ag NPs was maintained also after laundering. Moreover, antibacterial efficacy of the impregnated fabrics with Ag NPs was maintained also after many times laundering.