

Developing nanotechnology-based textiles for skin protection against UV radiation

Nafiseh Nasirzadeh¹, Mohammad Reza Monazzam Esmailpour¹, Farideh Golbabaei¹
Reza Faridi-Majidi²©

¹ Occupational Health Engineering, School of Public Health, Department of Occupational Health Engineering, Tehran University of Medical Sciences, Tehran, Iran.

² Department of Medical Nanotechnology, School of Advanced Technologies in Medicine, Tehran University of Medical Sciences, Tehran, Iran.

Abstract

To protect against the influence of ultraviolet (UV) irradiation from daily life and even changes in climate and stratospheric ozone, wearing UV-protective clothing is an effective approach to reduce skin damages from excessive UV exposure. So, the aim of this study was to develop nanotechnology-based textiles for skin protection against UV radiation.

In this study, the concentration 2wt.% of ZnO nanoparticles (ZnO-NPs) were used to treat the cotton textiles (100% cotton) by using pad-dry-cure method. In order to increase the adsorption of ZnO-NPs, once surface activation was provided with low pressure plasma and another time, the textiles were treated in presence of Citric acid (3wt.%) as a cross-linker. Characteristics of ZnO NPs were identified by UV–Vis spectroscopy, field emission scanning electron microscopy (FE-SEM), X-ray diffraction (XRD) and Fourier infrared transformation spectroscopy (FTIR). Also, morphological changes of the textiles were evaluated by using SEM-EDC and FTIR. Finally, ultraviolet protection factor (UPF) was calculated based on spectroscopy data.

The XRD pattern confirmed peaks assigned for ZnO-NPs. UV–Vis spectroscopy showed a peak absorbance in 363nm for ZnO-NPs. Also, ZnO-NPs had the spherical shape with an average size of 40.95 ± 9.27 nm. The FTIR spectra verified the existence of the functional groups of O–H, C=O, C=C and C-F. UPF for untreated textiles, treated textiles with cross-linker and treated textiles with plasma was 35.1, 183 and 404, respectively. These results showed that the highest UPF values were obtained when samples were treated by plasma

These results show that the treated cotton textiles have excellent protection categories when compared to untreated cotton textiles. Also, high UPF values have belonged to the textiles surface functionalization upon plasma treatment, due to the increased adsorption of ZnO NPs.

Keywords: Nanotechnology; UV radiation; Skin protection; Textiles; ZnO nanoparticles