

Poly(vinyl butyral)/nano-silver as a multifunctional coating for textile

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OBJECTIVE

The aim of this research was to enhance mechanical and spectrophotometric properties of a military camouflage cotton textile by applying a nano silver/poly(vinyl butyral) impregnation.

Ag: known for its unique optical, electrical, thermal properties and antimicrobial activity.

PVB: a thermoplastic elastomer chosen as a good impregnating matrix, with good adhesion, resistant to wetting.

MATERIALS AND METHODS

- PVB powder Mowital B30H (Kuraray GmbH);
- nano silver (US Research) 5-20 nm;
- ethanol 96% (ZorkaŠabac)
- military cotton fabric.

Impregnation: PVB was dissolved in ethanol in which nano Ag particles were ultrasonically dispersed; this solution was applied evenly onto textile and dried until ethanol evaporated. In the same way the sample was impregnated with PVB without nano Ag.

Round pieces of fabric were cut out for spectrophotometric, colorimetric and for abrasion resistance measurements. Specular gloss was measured using Elcometer 480 T, at the angle 85°. Diffuse reflectance and color coordinates were determined using Shimadzu UV VIS NIR spectrophotometer UV 3600.

Diffuse reflectance was measured in the area of the electromagnetic spectrum from 250-2000 nm. Color coordinates were measured in the visible part of the electromagnetic spectrum (380-780 nm), in CIE Measurement Lab space.

SDL Atlas Martindale Abrasion and Pilling tester was used to determine abrasion resistance of the material, in 30000 cycles.

RESULTS

Specular gloss:

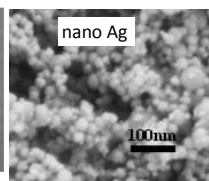
- sample coated only with PVB - specular gloss was 0.6,
- sample coated with PVB/nano Ag - it was 0.5,
- ✓ There is an improvement due to nano Ag; the gloss decreased.

- ✓ Nano Ag decreases diffuse reflection for both shades.
- ✓ Abrasion resistance, analysed by visual inspection, was better for the fabric impregnated with PVB/Ag than for the neat PVB.
- ✓ Color coordinates show that the difference could be seen by the observer's eye, but this might be avoided if nano Ag was included in the paint original formulation.

CONCLUSION

From the registered diffuse reflection it may be concluded that nano Ag is enhancing the camouflage behaviour of the material in the part of the spectrum for the selected shades. Specular gloss has not changed significantly. Colorimetry results indicate that the difference between the samples is visible to the observer's eye. Mechanical testing has shown that the addition of nano silver has improved the materials resistance to abrasion.

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Shimadzu UV 3600 spectrophotometer



Abrasion and Pilling tester

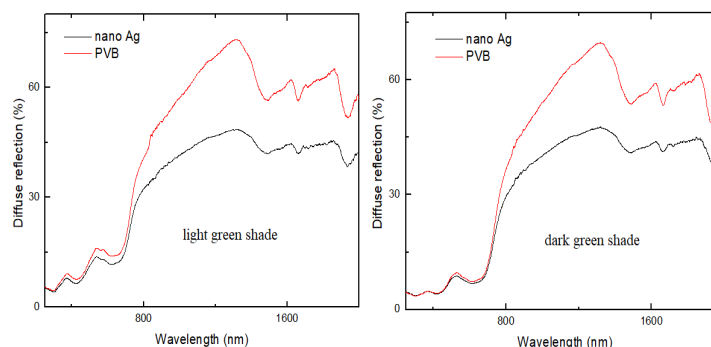


Ultrasonication

Color coordinates for light green and dark green shade

Material	L*	a*	b*	E
light green shade/PVB	46.05	-3.87	15.95	5.5
light green shade/PVB/Ag	41.02	-5.76	14.73	
dark green shade/PVB	35.05	-8.01	12.32	2.0
dark green shade/PVB/Ag	33.57	-7.47	11.05	

$\Delta E = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$ If ΔE is less than 1, the difference between two shades is not visible to the observer's eye.



Diffuse reflectance for the light green shade and the dark green shade