Effect of color substrate in structurally colored PES fabrics

Rui D. V. Fernandes(*), Jorge Padrão, Andrea Zille(**)

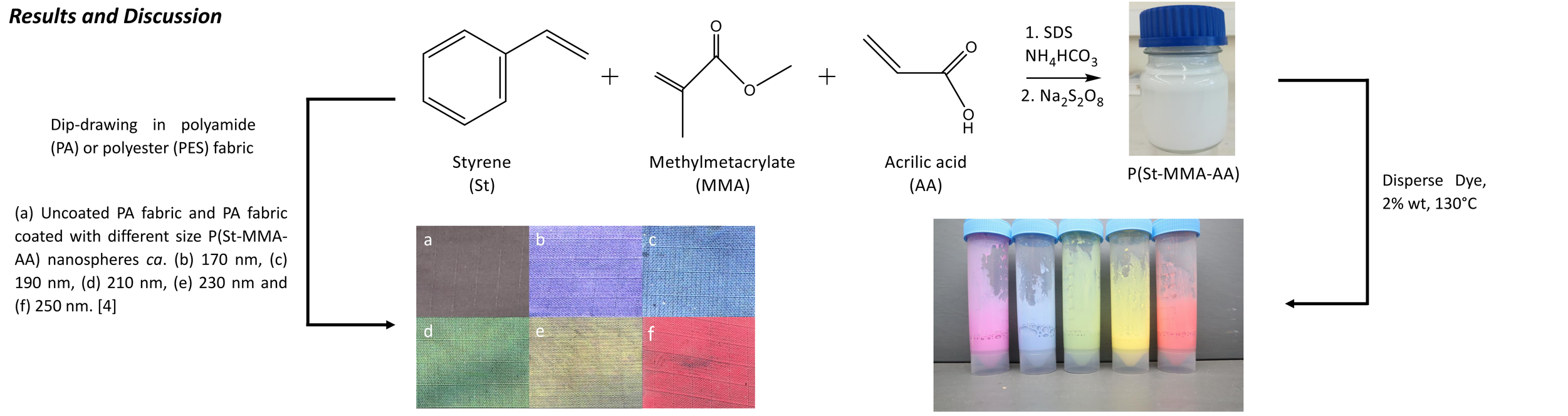
2C2T – Centre for Textile Science and Technology, University of Minho, Campus de Azurém, 4800-058, Guimarães, Portugal

(*) ruidvfernandes@gmail.com; (**) azille@2c2t.uminho.pt

Introduction

Textile Industry is one of the most pollutant industries in world, thus serious efforts are required to decrease its chemical and water demand, especially during dyeing processes. [1] One strategy to achieve this is the use of photonic crystals (PCs), where color is produced by interactions between light and highly organized nanostructures, called structural coloration. [2] Structural coloration is a more ecological method to add color to fabrics due to its low water consumption, as water is only needed in the synthesis of the photonic crystals. Also, PCs produce brilliant and iridescent colors that are not possible to obtain with conventional dyeing processes. [3] Therefore, in this work an alternative to conventional dyeing is presented, where PCs are applied onto dyed polyester fabrics through a dip-drawing method, and color properties are analyzed.

Results and Discussion



Green PCs (210 nm) were dyed with five different colors and several dippings were performed (PES fabric) to evaluate which samples had the best color, brightness and iridescence. A control sample with undyed PCs onto white polyester fabric was also prepared (but not shown), where structural color was not observed due to the reflection of all wavelengths, thus the fabric remained white.

Figure 1. Green PCs@Violet Disperse Dye in different colored PES fabric.

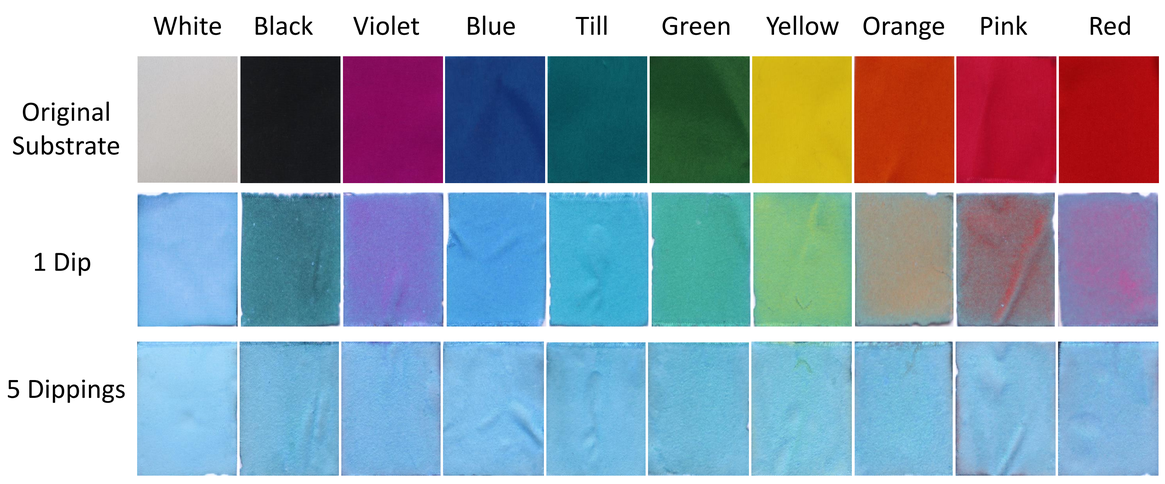


Figure 2. Green PCs@Blue Disperse Dye in different colored PES fabric.

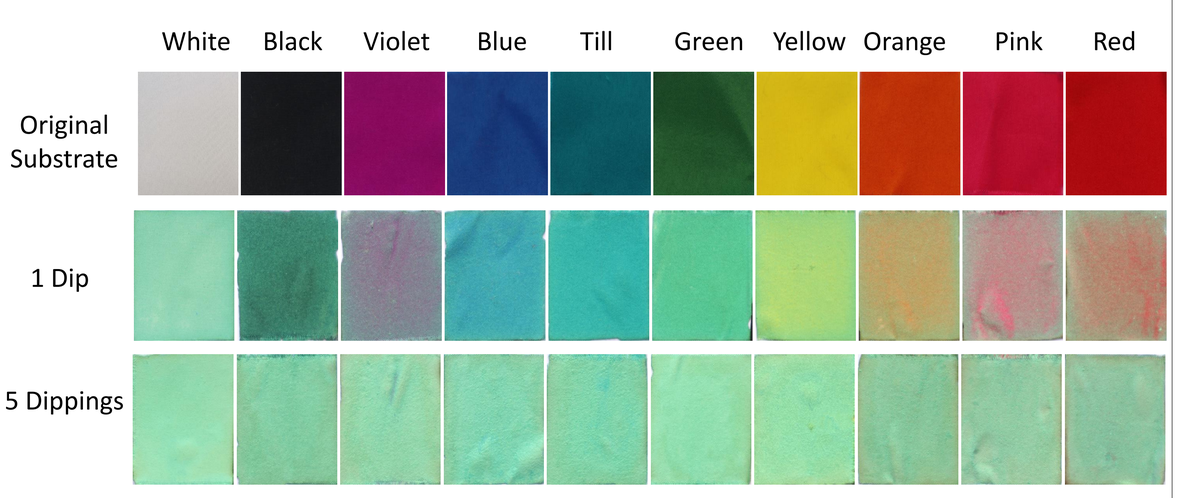


Figure 3. Green PCs@Green Disperse Dye in different colored PES fabric.

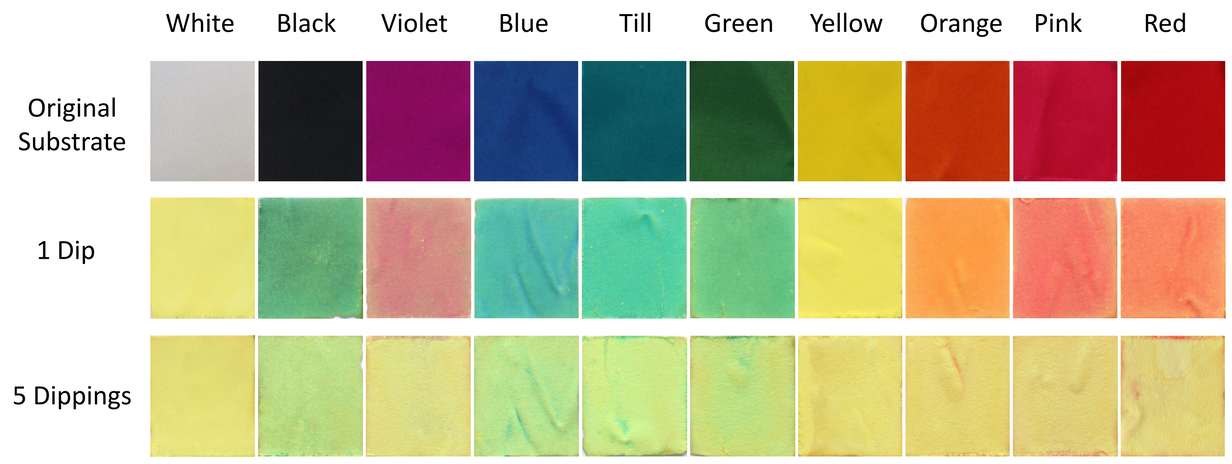


Figure 4. Green PCs@Yellow Disperse Dye in different colored PES fabric.

For all tested samples it was determined that five dippings were necessary to observe PC color and their effects. To overcome the color dye issue problem, green PCs were dyed at 0.5 and 1% wt with red disperse dye and their color was evaluated (Figure 5). After analysis of all tested samples, it was determined that the best color properties (combination of substrate and dye color and PC effect) were obtained in the group sample dyed with red disperse dye at 1% wt.

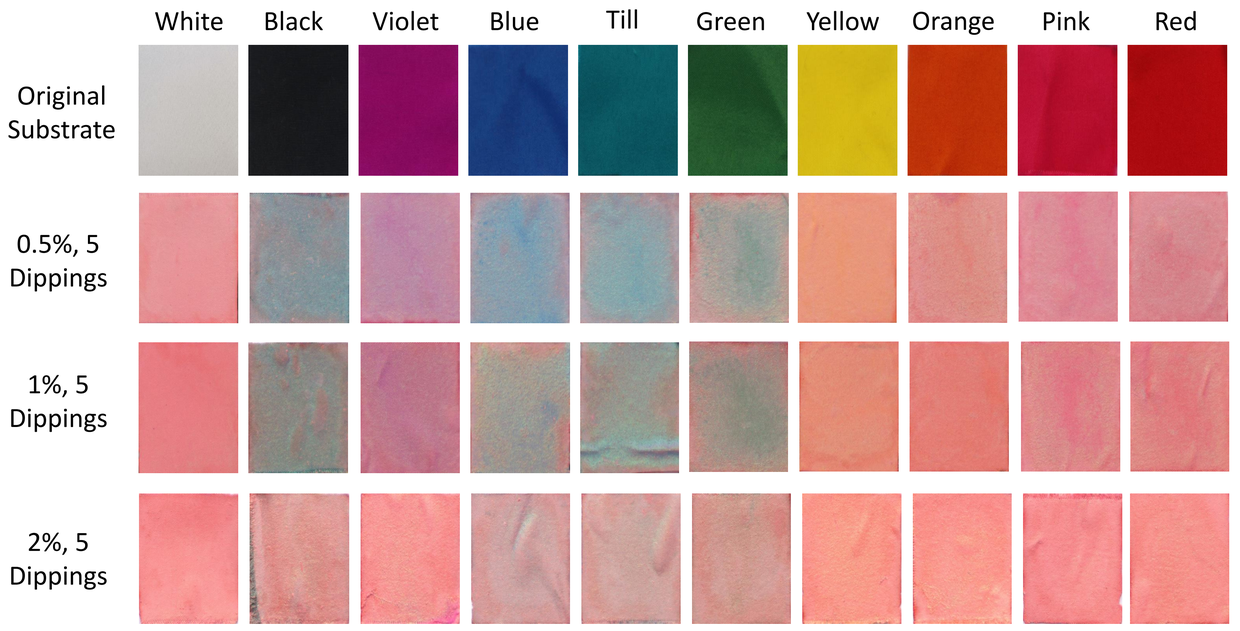


Figure 5. Green PCs@Red Disperse Dye at different concentrations in different colored PES fabric.

Conclusions

Coloration of fabrics *via* photonic crystal coating is a more sustainable method to color fabrics as the water and chemical consumptions are highly decreased. Although the disperse dye in 2% wt dyed PCs overwhelms all the other colors (PCs and substrate), it opens the possibility of refurbishing dyed garments without removing the previous dye, saving even more water. In the future, pristine and/or dyed PCs with different sizes will be mixed to tune certain colors and evaluation of the effects in structural color, brightness and iridescence will be analyzed.

Acknowledgments

This work was also funded by FEDER funds through the Operational Competitiveness Program—COMPETE and by National Funds through Fundação para a Ciência e Tecnologia (FCT)—under the projects PTDC/CTM-TEX/28295/2017, ARCHKNIT POCI-01-0247-FEDER-039733 and UID/CTM/00264/2019. Rui D.V. Fernandes acknowledge FCT, MCTES, FSE and UE PhD grant SFRH/BD/145269/2019.

References

[1] Z. Liu, Q. Zhang, H. Wang, and Y. Li, *Chem. Commun.*, vol. 47, no. 48, pp. 12801–12803, 2011.
[2] G. Yavuz, H. P. Felgueiras, A. I. Ribeiro, N. Seventekin, A. Zille, and A. P. Souto, *ACS Appl. Mater. Interfaces*, vol. 10, no. 27, pp. 23285–23294, 2018.
[3] L. Zhou, Y. Li, G. Liu, Q. Fan, and J. Shao, *Dye. Pigment.*, vol. 133, pp. 435–444, 2016.
[4] R. D. V. Fernandes, P. Gomes, A. Zille, and A. P. Souto, *Color. Technol.*, vol. 136, no. 2, pp. 101–109, 2020.

Cofinanciado por: