BLEND ELECTROSPINNING OF DYE FUNCTIONALIZED POLYMER NANOFIBERS FOR COLORIMETRIC SENSORS

K. De Clerck[1], E. Schoolaert[1], J. Geltmeyer[1], I. Steyaert[1], G. Vancoillie[2], R. Hoogenboom[2],
[1]*Department of Textiles, Ghent University, Technologiepark 907, 9052 Ghent*
[2]*Department of Organic and Macromolecular Chemistry, Ghent University, Krijgslaan 281 S4, 9000 Ghent*

Abstract

The development of smart colorimetric materials that sense the concentration of a specific analyte by a change in absorbance is particularly interesting, since a color change directly visible for the naked eye is obtained [1]. Color changing textiles play a prominent role among these colorimetric sensors due to their high flexibility, reusability, mechanical stability and breathability [2]. Halochromic, *i.e.* pH-sensitive, textiles may be highly valuable for various applications in the biomedical field, agriculture, safety and technical textiles. Electrospun sensor materials show a great potential due to their unique properties, resulting in improved sensor sensitivity and response time.

Functionalization of these polymer nanofibres can be done by doping the electrospinning solution prior to fibre formation with pH-sensitive dyes. This technique results in easy-to-produce halochromic nanofibres. Dye leaching, however, is a major problem. [3-4]
An alternative approach to reduce dye leaching is a covalent linkage of the dye to the polymer prior to electrospinning resulting in the most efficient immobilization method. Incorporation of the dye-containing polymer into a nanofibrous membrane can subsequently be achieved by blend electrospinning. Using this method robust halochromic nanofibers can be produced without the dye leaching drawbacks. [5]

References

1. P.T Mather, “Responsive materials: Soft answers for hard problems”, Nature Materials, 6 (2007), 93-94
2. L. Van der Schueren, K. De Clerck, “The Use of pH-indicator Dyes for pH-sensitive Textile Materials”, Textile Research Journal, 80(7) (2010), 590-603
3. Van der Schueren, L., Mollet, T., Ceylan, O., De Clerck, K. “The development of polyamide 6.6 nanofibres with a pH-sensitive function by electrospinning” European Polymer Journal 46 (2010) 2229-2239
4. Van der Schueren, L., De Meyer, T., Steyaert, I., Ceylan, O., Hemelsoet, K., Van Speybroeck, V., De Clerck, K. “Polycaprolactone and polycaprolactone/chitosan nanofibres functionalised with the pH-sensitive dye Nitrazine Yellow” Carbohydrate Polymers 91 (2013) 284-293
5. I. Steyaert, G. Vancoillie, R. Hoogenboom, K. De Clerck, “Dye immobilization in halochromic nanofibers through blend electrospinning of a dye-containing copolymer and polyamide-6”, Polymer Chemistry, 6 (2015) 2685-2694