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TECHNOLOGY OFFER

PLASMA DYE COATING: A NEW AND WIDELY APPLICABLE METHOD TO COLOUR OR CREATE SENSING MATERIALS

We are seeking partners interested to explore/investigate our new procedure to create smart colorimetric materials.

INTRODUCTION

Dyeing of different material is of interest, especially the creation of smart colorimetric materials that sense the difference in concentration of a specific analyte by inducing a colour change where the unambiguous output signal is directly visible for the naked eye. The majority of these sensing materials are made by incorporating an analyte-sensitive dye on carrier materials. Two different fabrication processes based on this principle can be used to synthesize these smart materials. The first commonly used method is so-called **dye doping**, which involves the addition of a suitable dye into the feed mixture prior or during the polymer processing. This will result in a strongly and homogenously colored material due to the incorporation of the dye into the bulk of the material. The second dye functionalization approach is based on introducing the dye to the material after it is fabricated, most commonly using a simple **staining method**. The main issue with these two fabrication processes is that the added dye is only immobilized by physical interactions potentially leading to significant **dye leaching** during their application resulting into a loss of sensitivity or output signal and possible toxicological responses depending on the application. The development of a new dyeing process with a more covalent nature is necessary to suppress this main disadvantage.

KEYWORDS

Sensors, Dyeing, Plasma Surface Treatment, Post-fabrication method, Polymeric material, analyte-sensitive dyes

TECHNOLOGY

Researchers at Ghent University in the research group of prof. Hoogenboom have invented the **Plasma Dye Coating (PDC) procedure** to overcome these advantages by covalently immobilize sensing dye molecules on different polymeric surfaces. In this PDC method a more radical approach is used to bind the dye molecules to the substrate using high energy plasma surface treatment. By applying this treatment to the surface in the presence of previously adsorbed dye molecules, the formed radical can covalently immobilize the chosen dye on the material surface.

APPLICATIONS

The PDC dyeing process is a new **post fabrication method** which can be used to color different polymeric substrates by covalently immobilizing dye molecules via plasma surface treatment. The materials created by this new method have far more economic potential then the previously discussed approaches as no more dye leaching occurs, the treatment time is short and is applicable to all polymeric substrates. By choosing a stimuli responsive dye that can detect a specific analyte, sensors can be made which can detect a change in pH (halochromism), temperature (thermochromism), light (photochromism) and solvent (solvatochromism). These sensors can then be used in different fields, e.g. for pH sensitive sensors: smart wound dressing and sensor for spoiled fish

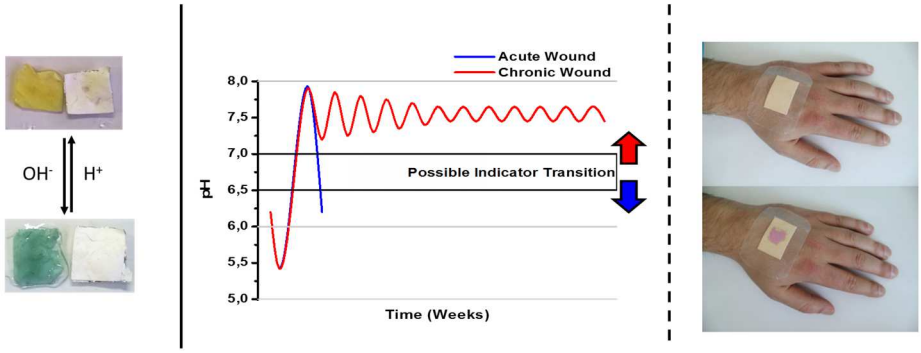

Figure 1. Right: Reversible halochromic behavior of a pH sensitive dye after PDC modification compared to the untreated material. Left: Example of a smart wound dressing which can detect the early stage of infection by changing color.

ADVANTAGES

- Sustainable colored materials: no dye-leaching occurs during application
- The PDC process is a post fabrication method which colors polymeric materials without interfering with the existing fabrication method.
- By choosing a specific stimuli responsive dye this procedure can easily switch to the creation of sensing material
- This post fabrication method makes it possible to incorporate the PDC method in a continuous industrial process
- Low amounts of dye necessary for the coating which makes it economically interesting to use also more expensive dyes
- PDC procedure is material independent, e.g. Polyethylene, Polypropylene, nonwoven Polyamide
- Short treatment time

STATUS OF DEVELOPMENT

The PDC procedure was successfully used on various materials including high density polyethylene, low density polyethylene, propylene, polytetrafluoroethylene, nonwoven polyamide and nonwoven cellulose to immobilize a wide variety of different pH-sensible dye molecules including azobenze, rose bengal and sulphonphtalein derivatives. The color change of these materials triggered by the exposure to acid and basic environment shows us that the sensing properties of the dye are retained using the PCD procedure.

PARTNERSHIP

Ghent University is seeking partners for further evaluation or co-development of our Plasma Dye Coating Technology tailored for your application. We can offer you with a licence or option agreement to license.

INTELLECTUAL PROPERTY

Patent pending

REFERENCES

Steyaert I, Vancoillie G. Dye immobilization in halochromic nanofibers through blend electrospinning of a dye-containing copolymer and polyamide-6. *Polymer chemistry*, 2015:1-3. doi:10.1039/x0xx00000x

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