Chromic Textiles: from molecular design to textile design



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- For traditional applications
- Require a uniform, reproducible, stable colour
- A change in colour, eg., due to exposure to light, heat, was a defect
- There are niche applications for colour change materials, especially if
- controllable
- reversible



Chromic materials

• Dyes and pigments that react to environmental conditions and stimuli, by changing colour.



Chromic materials

Chromism

- Photochromism
- Thermochromism
- Ionochromism
- Electrochromism
- Solvatochromism
- Piezochromism, Tribochromism
- Gasochromism, Vapochromism
- Chronochromism,
- Biochromism

Stimulus

light heat

ions (eg., pH)
electrical
solvents
mechanical
gases
time
biological sources

Challenges of chromic materials for textiles



- limited in scope and availability
- relatively expensive.
- not developed specifically for textiles
- cannot necessarily be used in the same way as traditional dyes and pigments
- limited access to technical expertise, information and support.
- limited stability in certain environments
- associated with novelty / gimmicks

Our approach to chromic textiles



- Developing a methodology for objective assessment of the colour change properties
- Optimisation of application methodology for textiles
- Computer-aided molecular *design* and synthesis of chromic materials specifically for textile applications



- Develop colour in UV light (e.g., sunlight)
- Revert to colourless when the light source is removed
- Spectacles which become sunglasses

Applications of Photochromic

Dyes













Application and evaluation of commercially available photochromics on textiles

Commercial photochromic dyes screen-printed at 0.05% concentration – exposed to UV.





Photochromic printed textiles - washfastness and lightfastness



Molecular design and synthesis of photochromics for textiles



- Provides solubility in water
- Provides affinity for the fibres
- Dyes fabric (wool, silk, nylon) as an *acid dye* to give a colourless fabric which acquires a blue colour on irradiation
- Useful for digital (inkjet) printing



- EC Framework 6 Integrated Project
- Digital Fast Patterned Microdisposal of Fluids for Multifunctional Protective Textiles
- (Inkjet printing of functionality)
- Around 30 partners



Inkjet printed photochromic cotton





Before exposure

After UV exposure



Coloured to **coloured** photochromics, by design



- Computer-aided molecular modelling allows
- Prediction of photochromism
- Prediction of original colour
- Prediction of colour after irradiation

Modelled structures of compound 1 and its ring-opened forms 2a-2d







140 minutes

120 minutes

Photochromic textiles

UV exposure





Thermochromism

• Colour change activated by temperature change











Thermochromic Liquid Crystals

Spectrum of colours produced by interference Requires a black background



Assessment of liquid crystal thermochromics printed on textiles



Variable temperature colour measurement



Heat- sink technology applied directly to thermochromic fabric.







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