

# “The Chemistry Of Textiles”

Vivimed Labs Europe Ltd  
Photochromic Colorants

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# Vivimed Labs Europe Ltd

- Then...

1840s

- Company started life as James Robinson
- Natural dyes traded

– mid to late 20<sup>th</sup> century

- Rise and fall of sulphur dye business
- Moved into:
  - hair dyes
  - photographic chemicals
  - plants

- Now...

– 21<sup>st</sup> century

- Growth of photochromic dye business
- Change of ownership (2008) and name (2010)



Vivimed

# Colorants



- Hair colorants
- Photochromic dyes
- Semiconductors



# Hair Coloration: “Low Temperature Fibre Dyeing”

Wool and hair are both protein fibres but...

## Wool

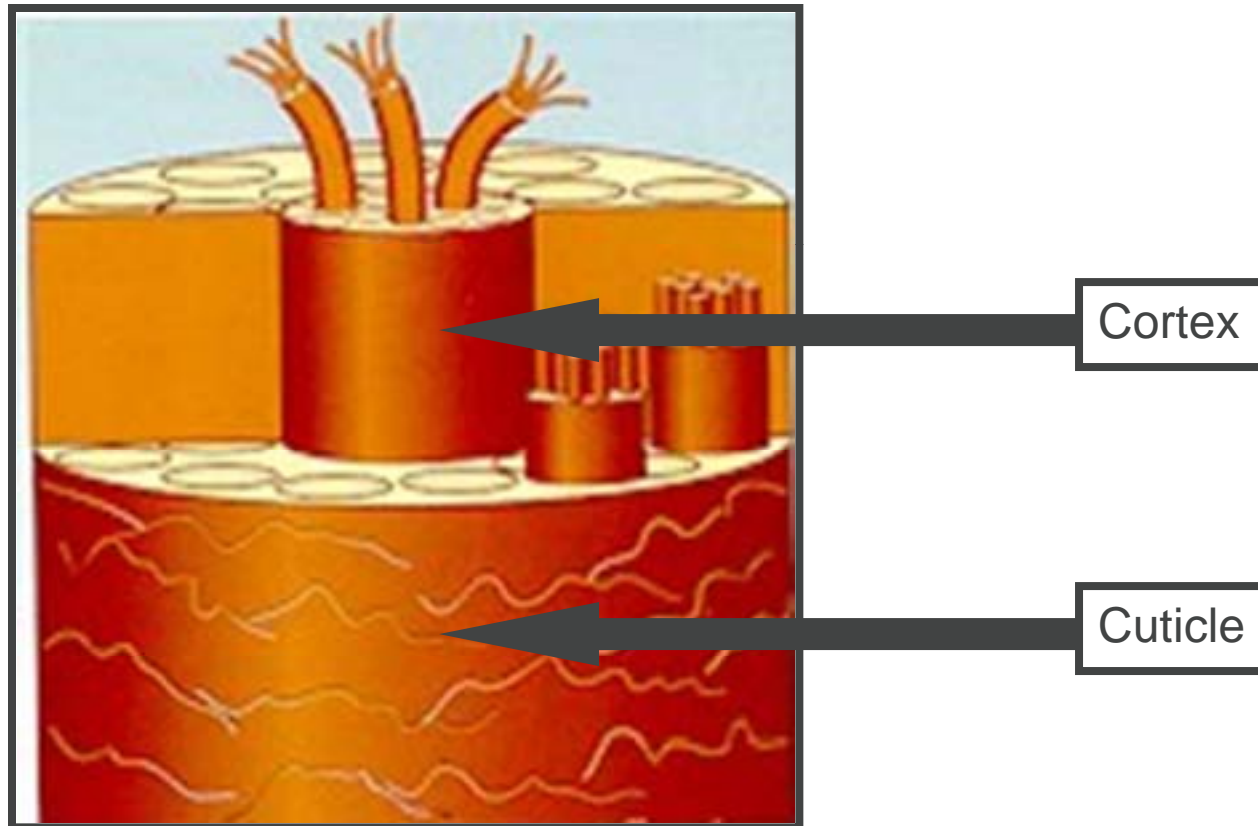
- Traditionally dyed with:
  - acid dyes
    - applied at boil
    - typically pH <4
  - chrome and mordant dyes
    - often as per acid dyes
    - heavy metals
  - reactive dyes
    - fixation usually at the boil
- Processes all >1hr

## Hair

- Conditions restricted:
  - temperature
  - pH
  - time
  - liquor ratio
- Performance required:
  - limited pre-treatment
  - intensity
  - level coloration



# Hair Coloration: The Challenge



# Hair Coloration: The Solutions

Temporary

Semi-permanent

Permanent

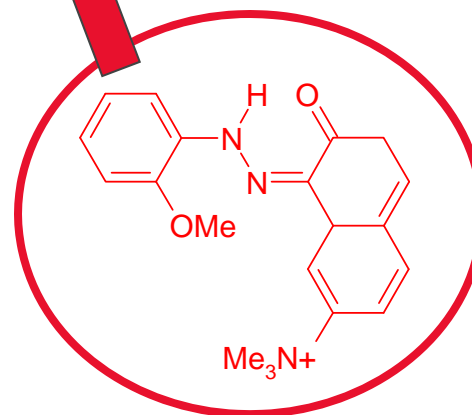
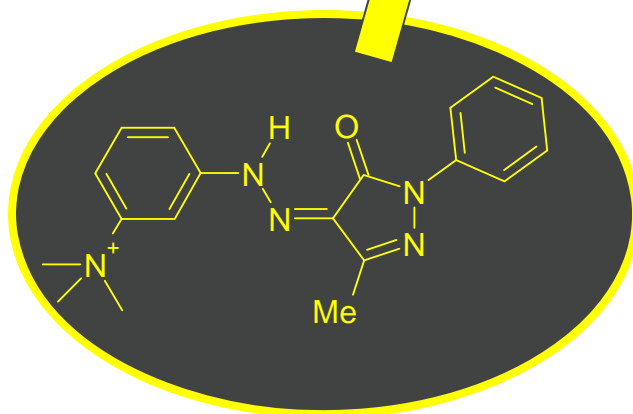
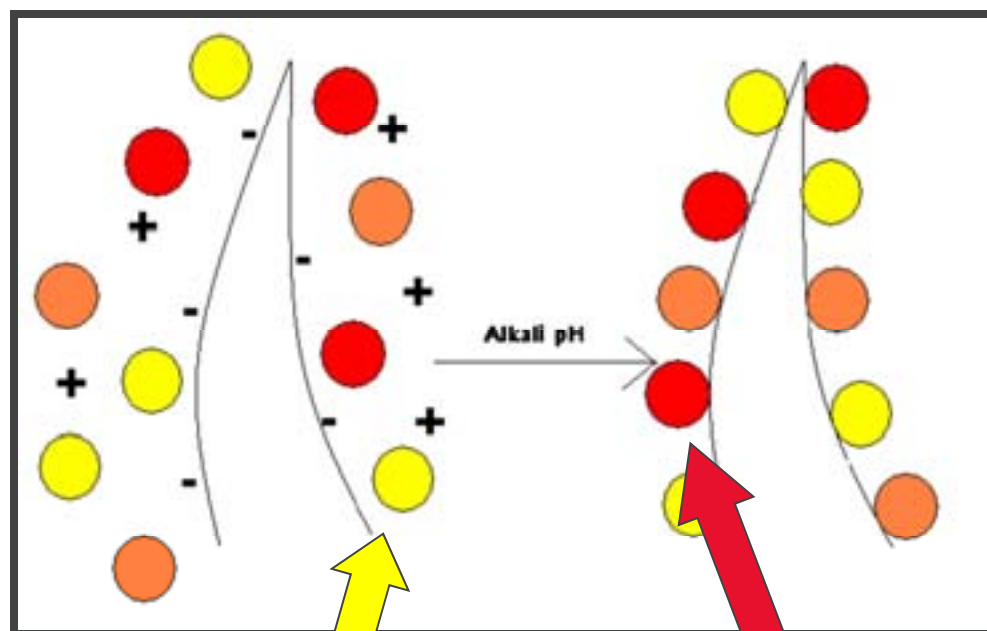


# Temporary Hair Dyes: Properties

- Relatively large cationic dyes
- Similar to 'basic' dyes for acrylic fibre
- Some even re-purposed textile dyes
- Adsorbed to hair fibre
- Application in 5 minutes
- Used in:
  - shampoos
  - conditioners
  - mousses
- Lasts 1-2 washes

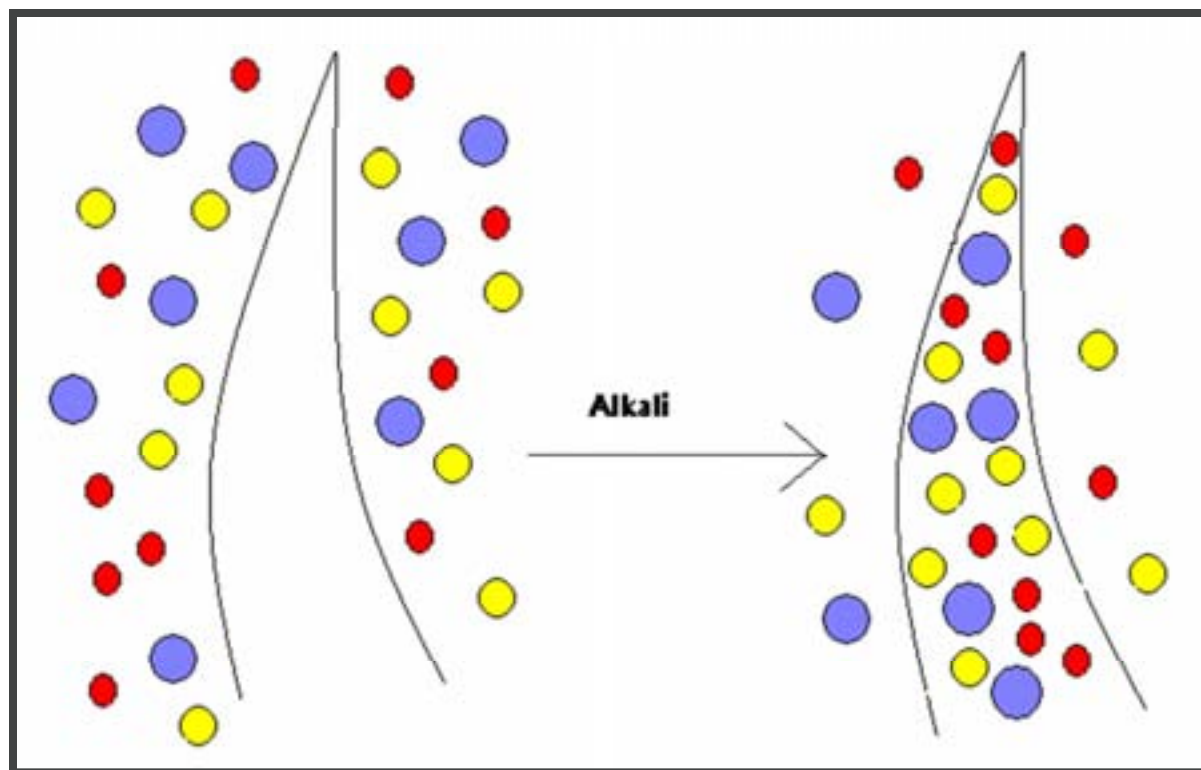


# Temporary Hair Dyes: Chromophores

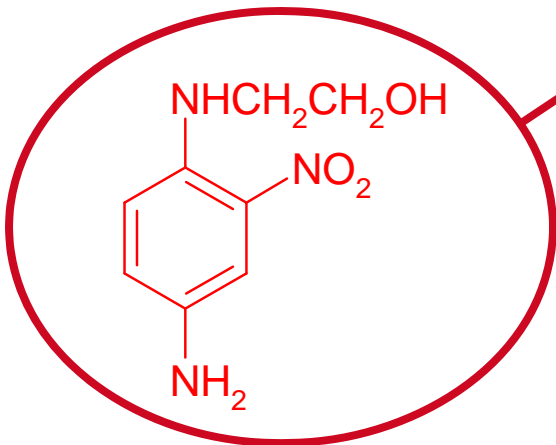
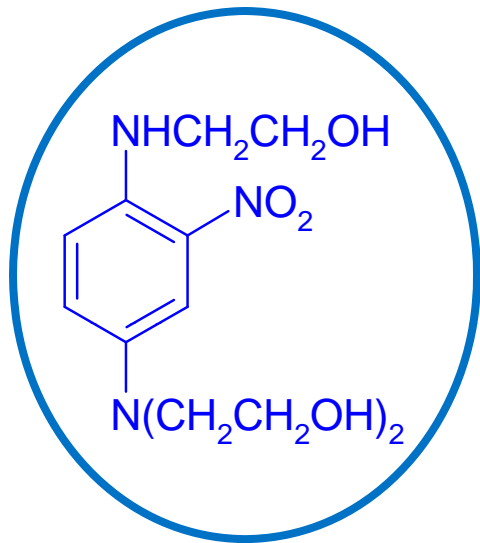




# Semi-Permanent Hair Dyes: Mechanism



# Semi-Permanent Hair Dyes: Properties



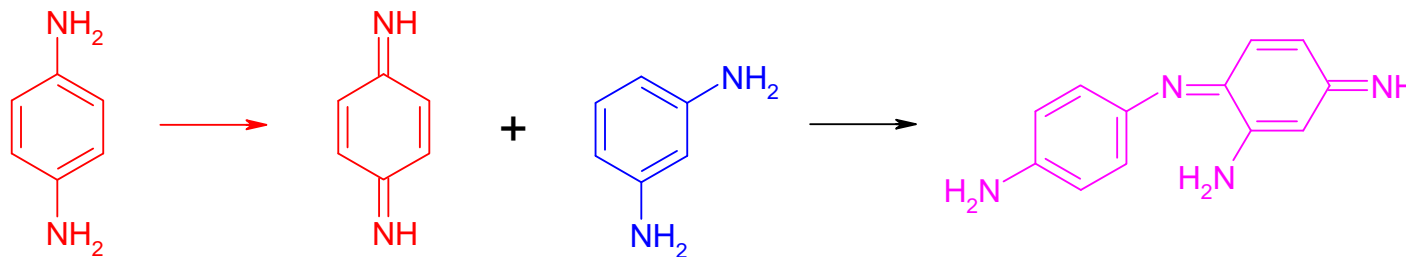
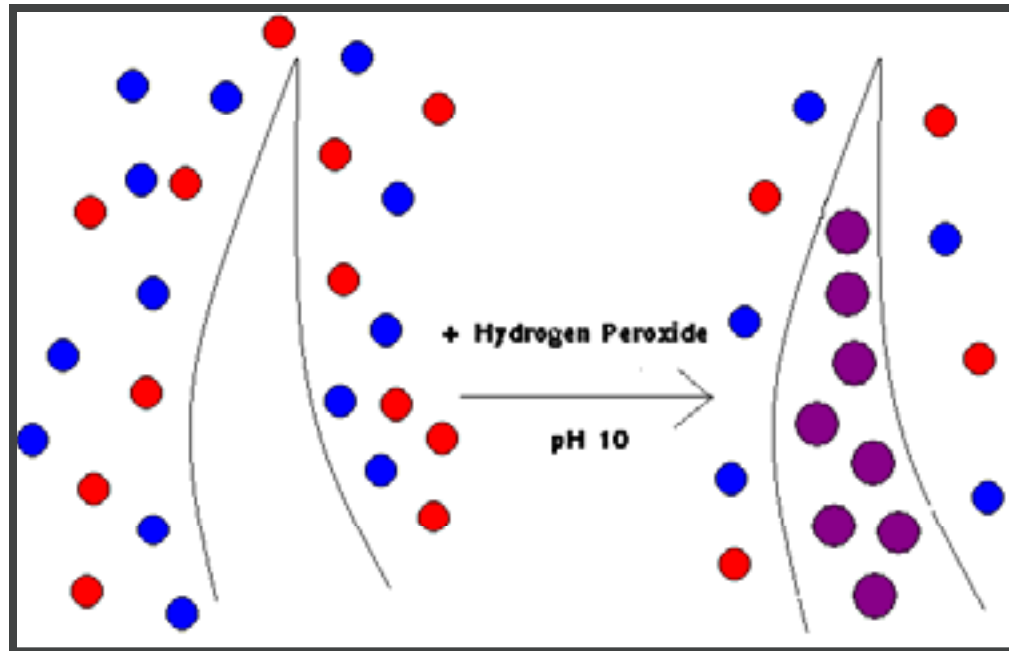
Up to 8-10 washes

# Permanent Hair Dyes: Mechanism and Properties

- Three main components:
  - primary intermediates (oxidation bases)
  - couplers
  - oxidant
- Reactive system:
  - components mixed
  - couplers and primary intermediates diffuse into hair fibres
  - primary intermediates oxidised
  - couplers react with oxidised primary intermediates to form colorants
- Process typically takes 20-40min
- Colorants relatively large in size:
  - slow to diffuse out of hair fibre
  - coloration permanent



# Permanent Hair Dyes: Chromophores



# Photochromic Dyes



## Applications

- Non-textile
  - Ophthalmic lenses
  - Plastics
  - Security printing
- Textile
  - Yarn
  - Screen printing
  - Accessories



# Photochromism: Definition

## Photochromism

- *“A reversible colour change induced in a compound driven in one or both directions by the action of electromagnetic radiation”*



# Photochromism: Types of Dye

- T-type

- spiropyran
- spironaphthoxazine
- naphthopyran

- P-type

- fulgide
- diarylethene

most commercially important

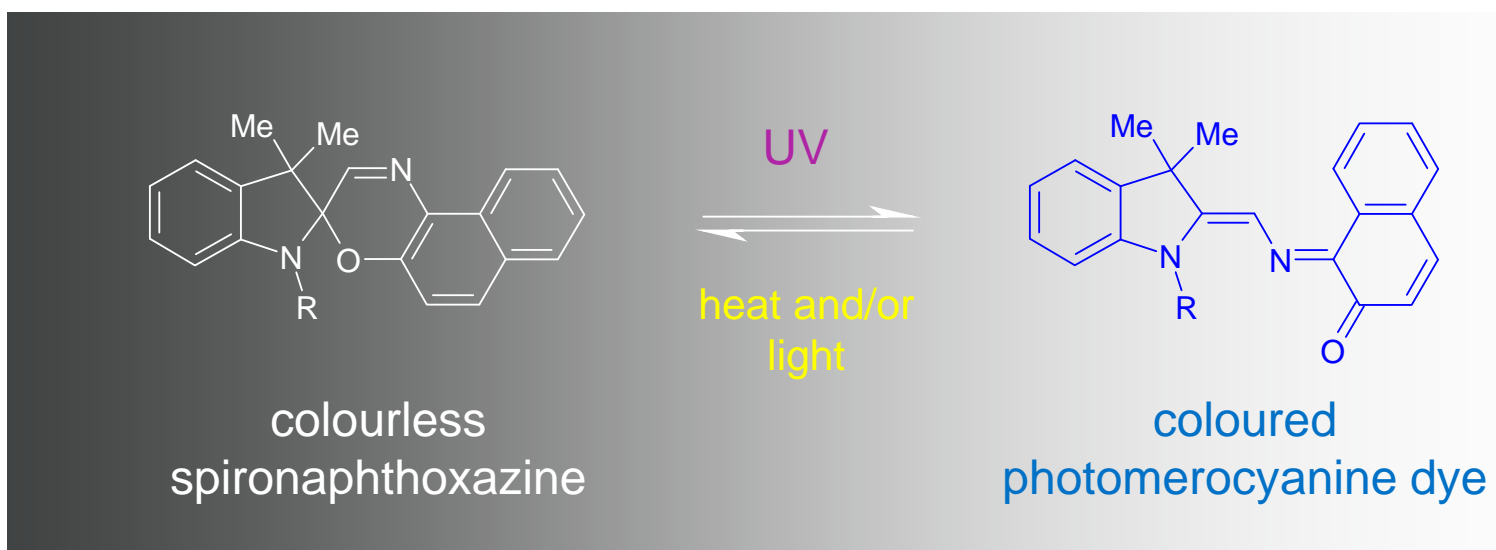


# Photochromism: Commercial Dyes





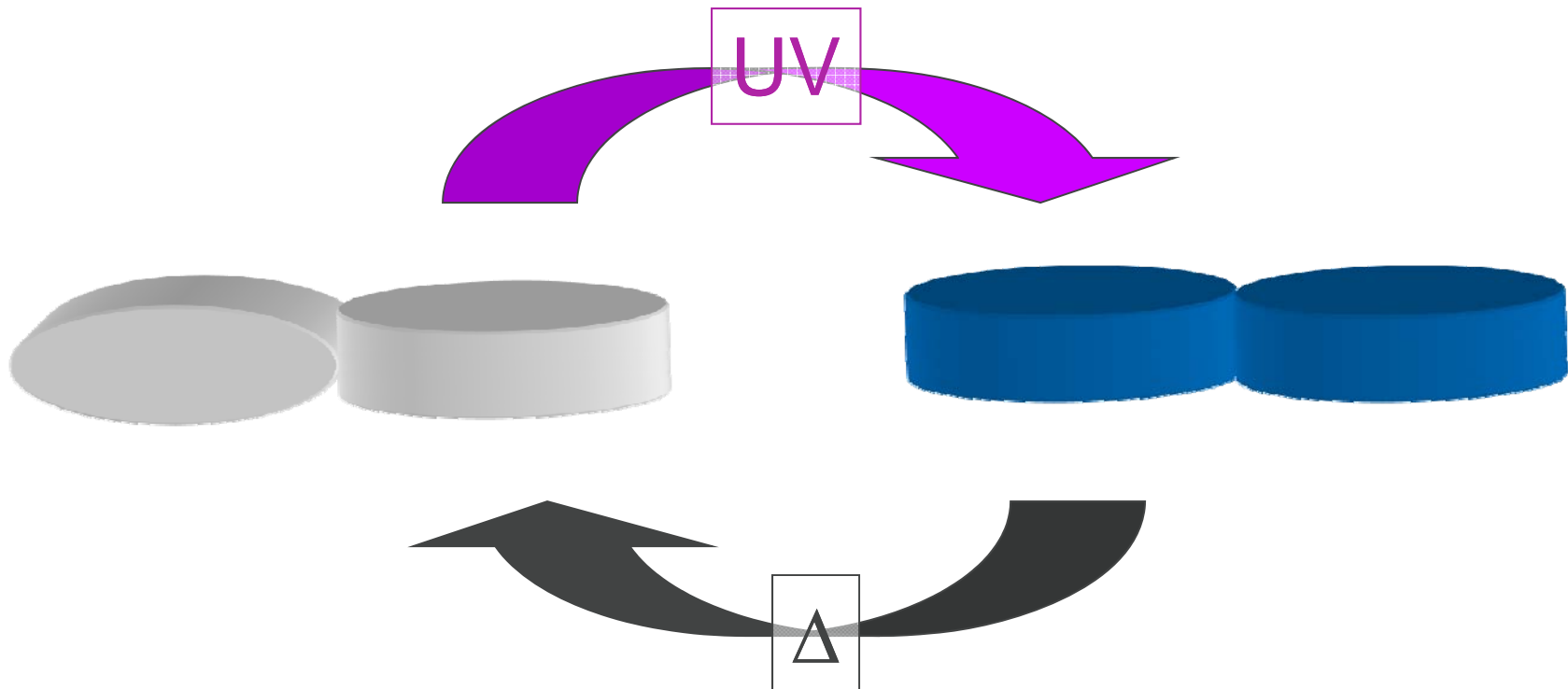
# Photochromism: Mechanism



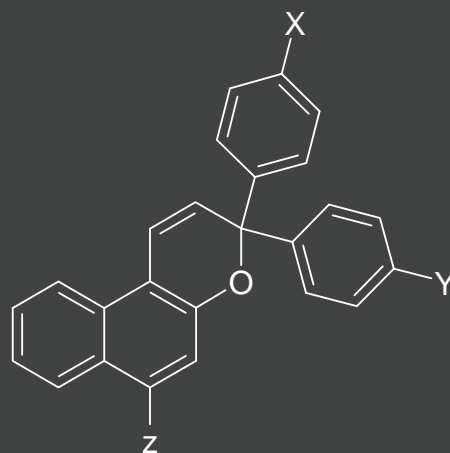
Exclusively thermal fade : 'T-type' photochromism



# Photochromism: Mechanism



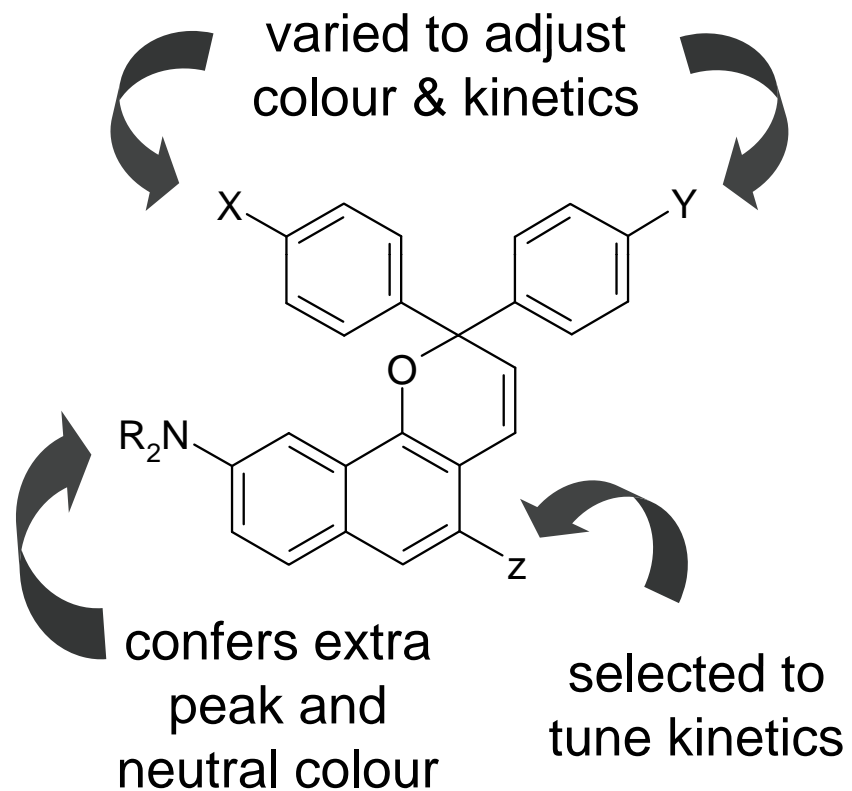
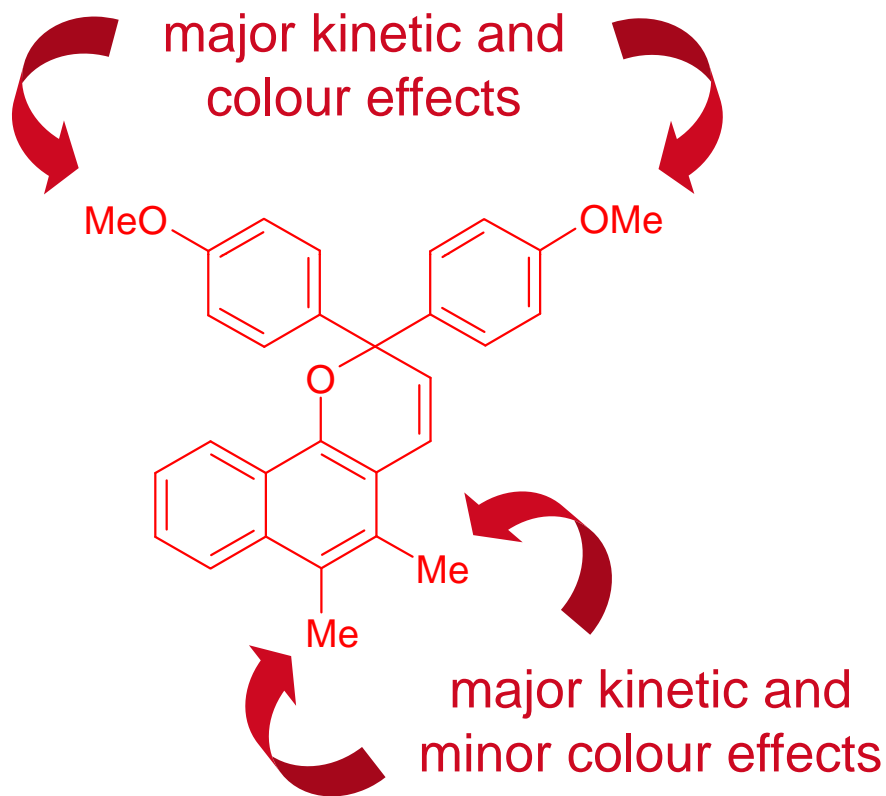
# Photochromism: Commercial Dyes



X	Y	Z	colour
H	H	H	weak yellow
H	H	amino	strong yellow
OMe	OMe	H	weak orange
OMe	OMe	amino	strong yellow
amino	H	amino	strong orange



# Photochromism: Neutral-coloured Dyes



# Photochromism: Limitations

- Medium
  - certain polymers
- Photostability
  - use of additives
- Mixtures
  - activation
  - fatigue
- Application method
  - mass coloration
  - screen printing
- Reversibility

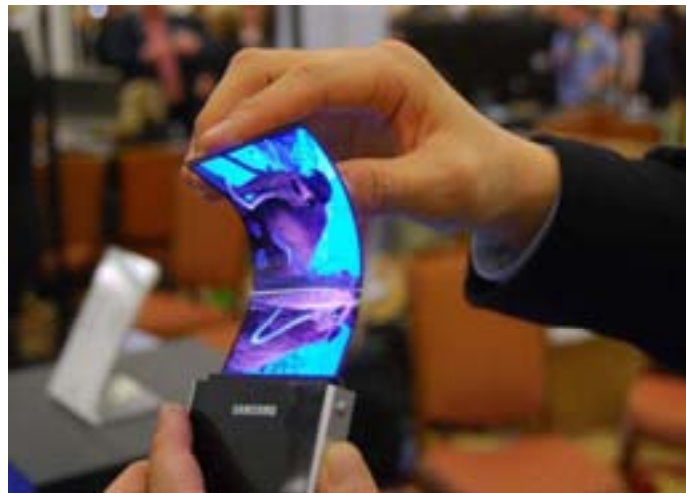


# Semiconductor Dyes: Textile Applications

- Wearable devices
  - genuinely smart fabrics
  - integration of existing technologies
- Organic semiconductors
  - flexible substrates
  - printable circuitry



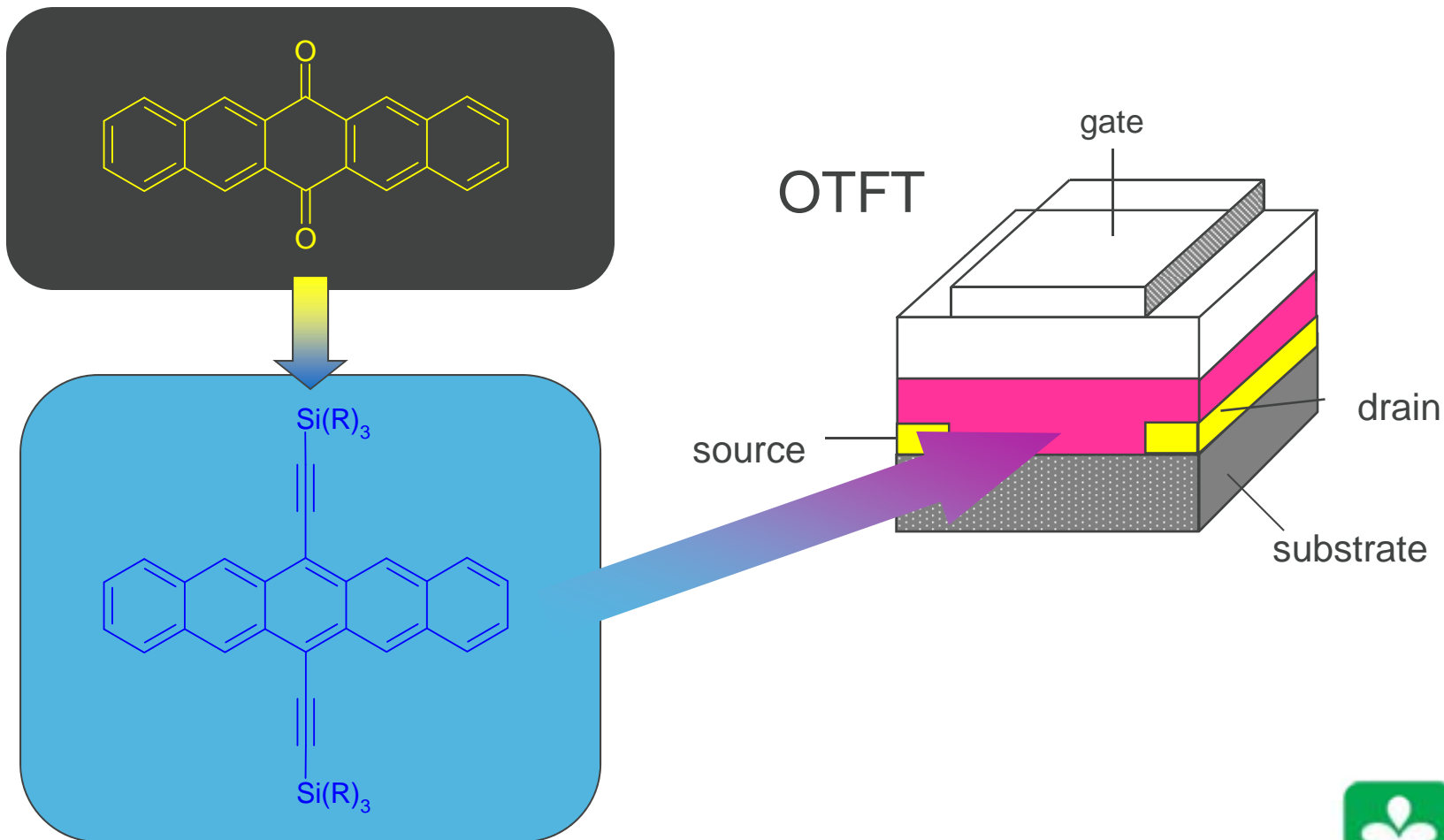
Organic Thin  
Film Transistors  
(OTFT)



[itechfuture.com](http://itechfuture.com)



# Semiconductors: Functional Colorants



## Further Information

- Photochromic dyes
  - Corns, Partington and Towns, “Industrial Organic Photochromic Dyes”, *Coloration Technology* 125 (2009) 249-261
- Hair colorants
  - Morel and Christie, “Current Trends in the Chemistry of Permanent Hair Dyeing”, *Chem. Rev.* 111 (2011) 2537-2561
- Organic electronics
  - Anthony, “Functionalised Acenes and Heteroacenes for Organic Electronics”, *Chem. Rev.* 106 (2006) 5028-5048

[www.vivimedlabs.com](http://www.vivimedlabs.com)



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