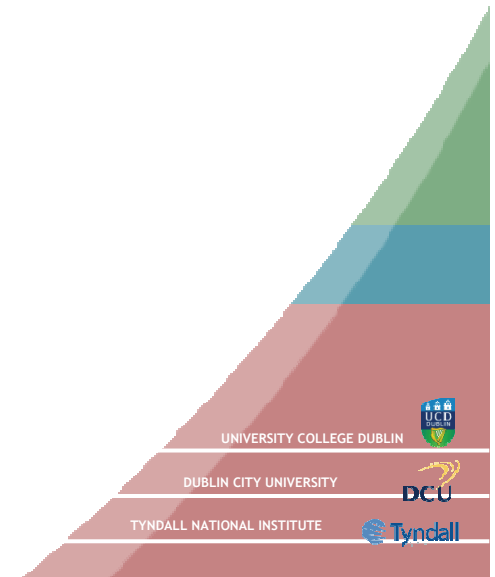




# Light-modulated ion binding: Towards calibrationless sensors

Pittcon 2009

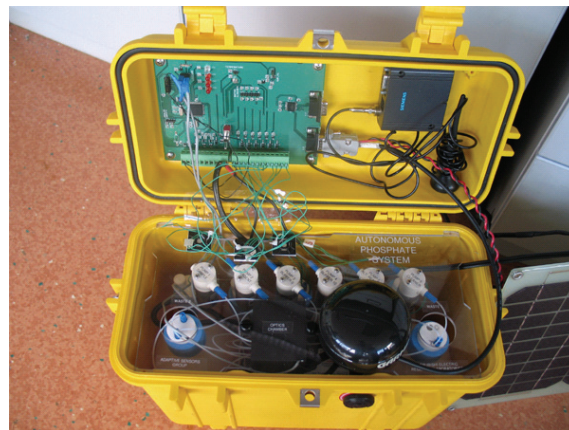


# Outline

- Concept of light-modulated sensing
- Addressing the issues of spiropyran as a ligand in light-modulated sensing
  - Photodegradation
  - Sensitivity
  - Reversible sensing
- LED-based sensing

# What is wrong with calibration?

Autonomous, deployable sensing devices become very **complicated** and **costly**



# Principle of sensing

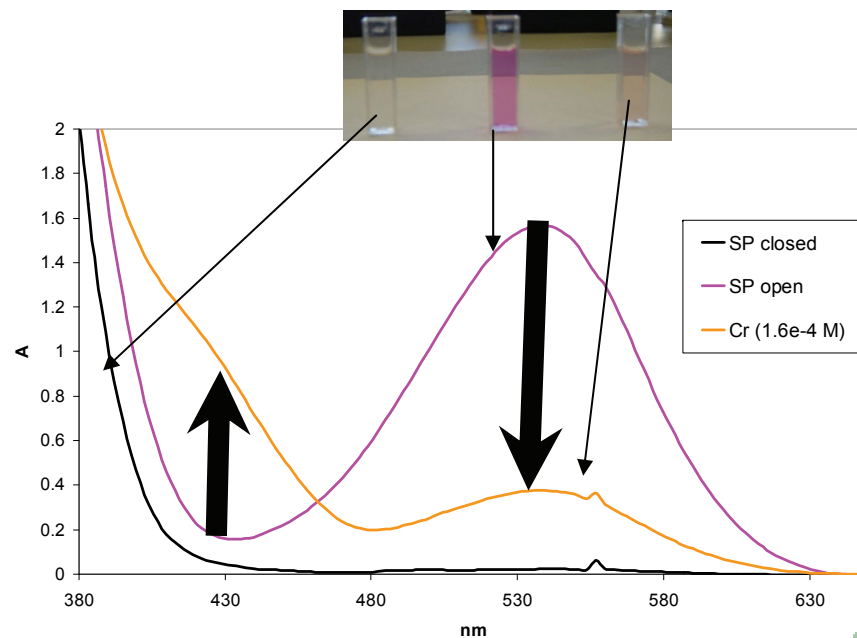
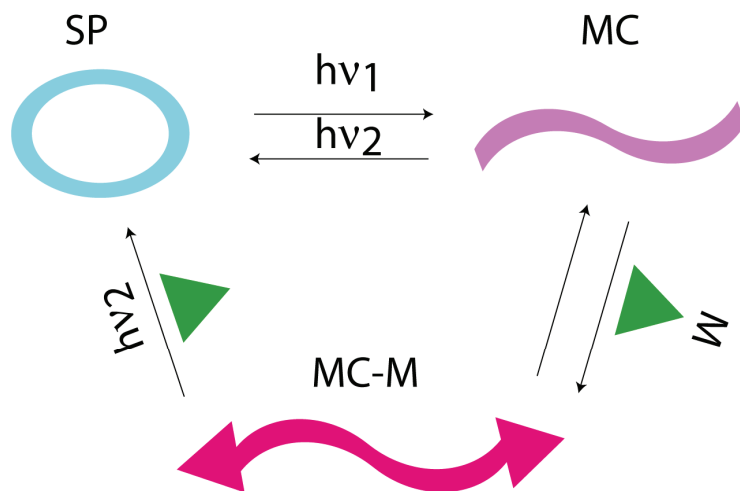
- Physical transducers (temperature, pressure, light density, movement...) do not need to be in direct contact with 'the sample' - can be shielded in a protective enclosure
  - Functionality is often tested by measurement of resistance, current...
- Chemical sensors and biosensors **depend on selective reactions happening at a active surface - must be directly exposed to the sample**
  - Device surface **MUST** change to generate a signal - but regeneration of original surface characteristics is extremely difficult

**Ideally, a fresh, identical surface should be available for every measurement!**

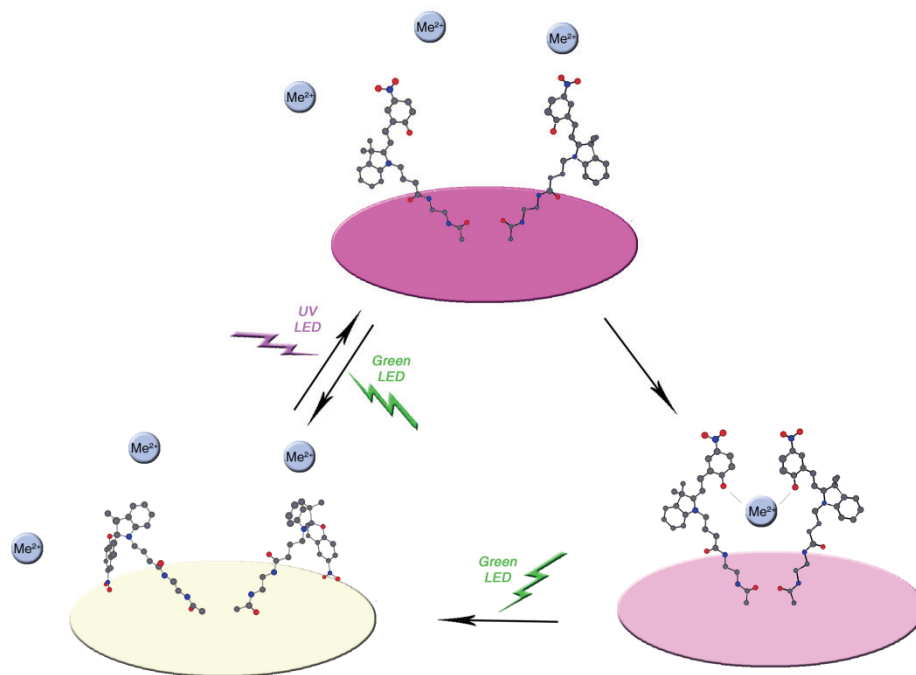
# How to reduce the need for calibration?

- Use external stimuli to activate/passivate sensing surface
- Use electrical signal as a diagnostic tool for the state of a sensor (S501a Monday @10:45 am)

# User-controlled, 'smart' sensing

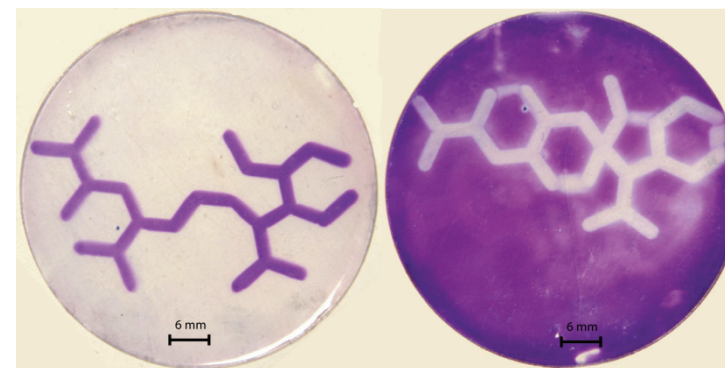


# Surface Immobilization

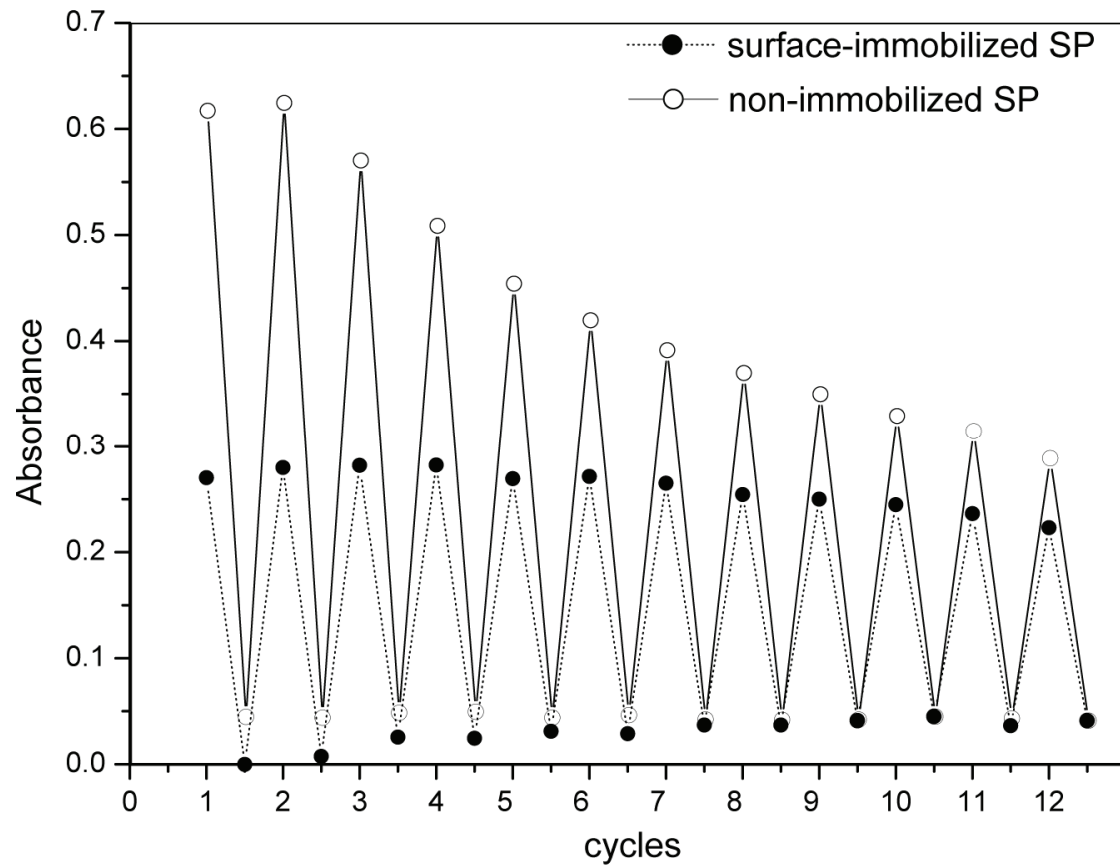


## Extra benefits

- Increasing life time (no leaching of SP and spatial control)
- Low cost platform
- Reducing photodegradation?

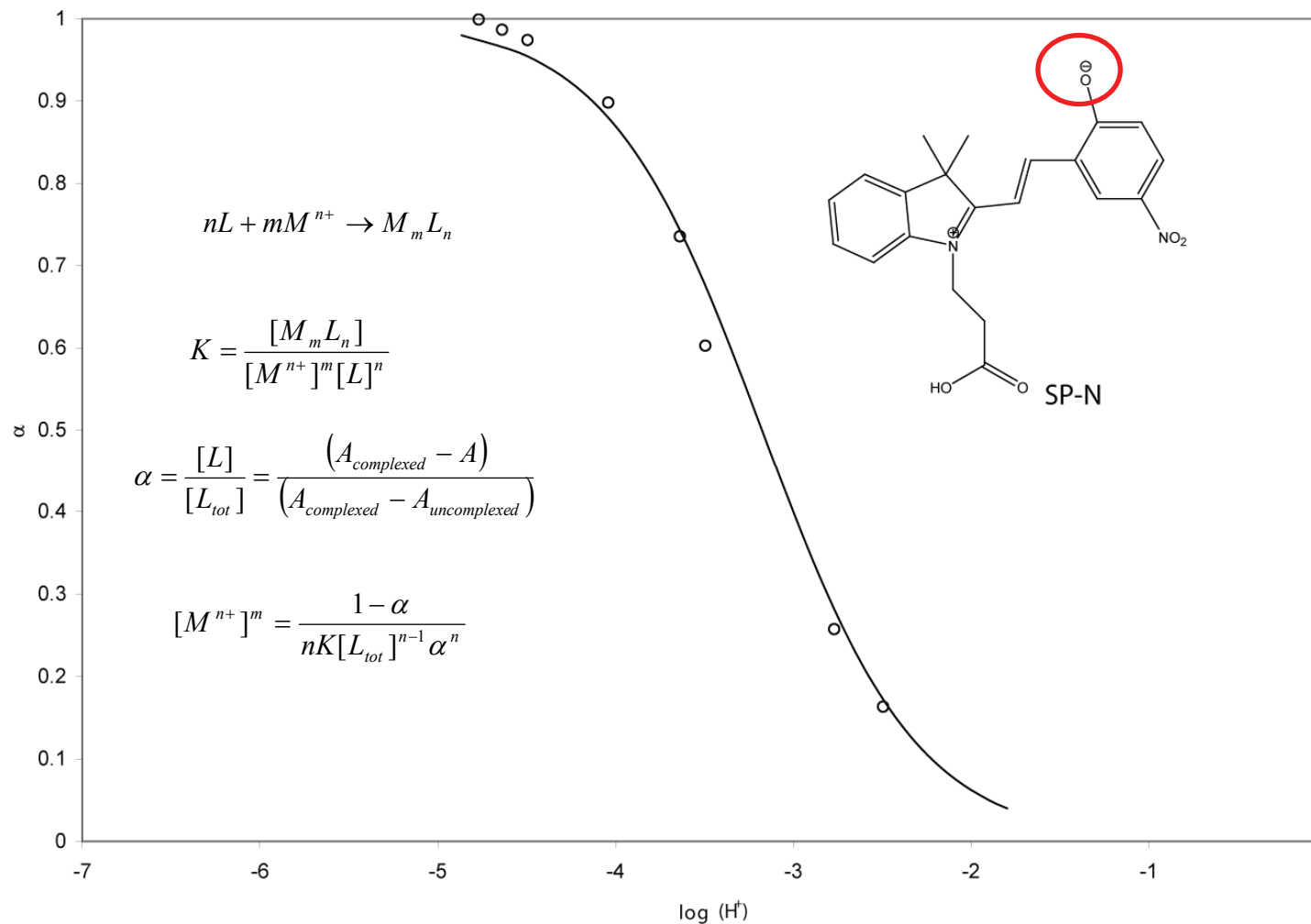


# Photodegradation

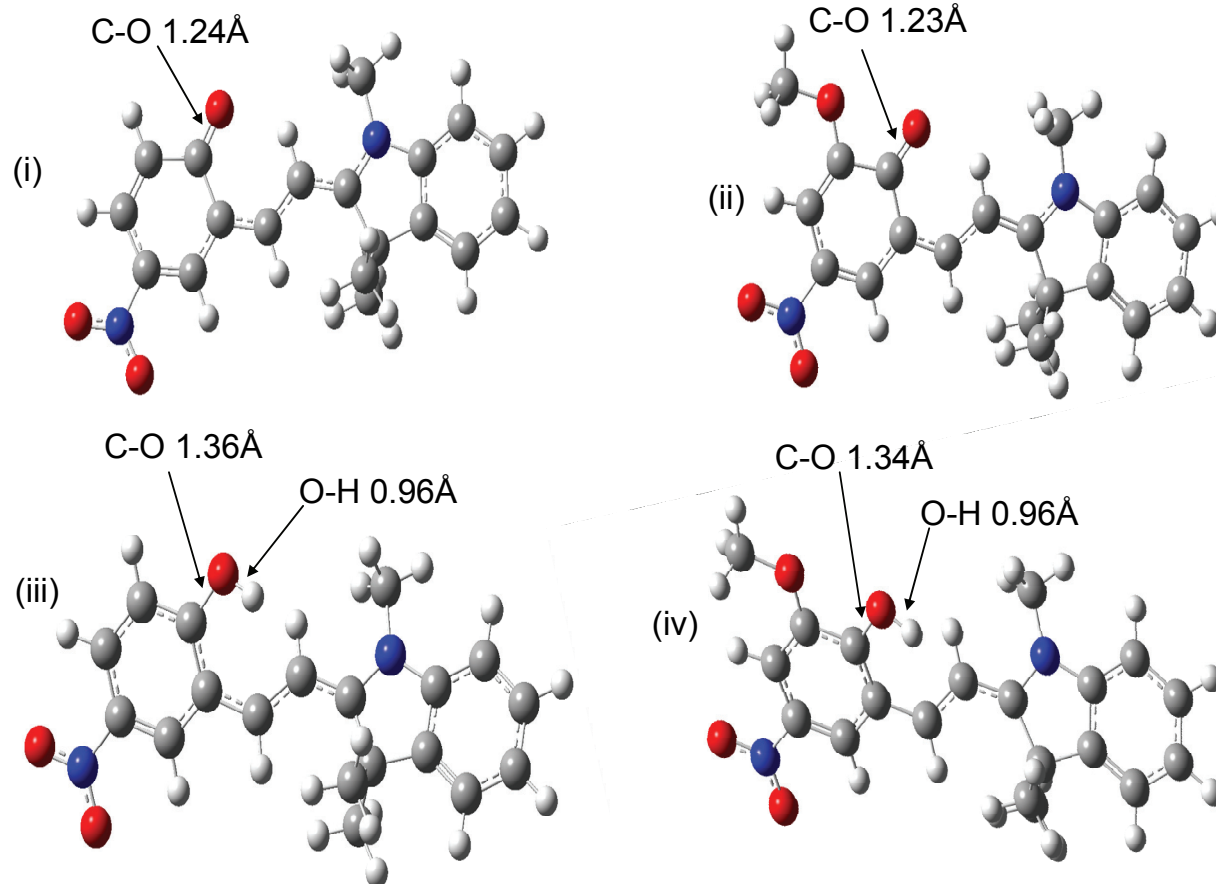




# Sensitivity

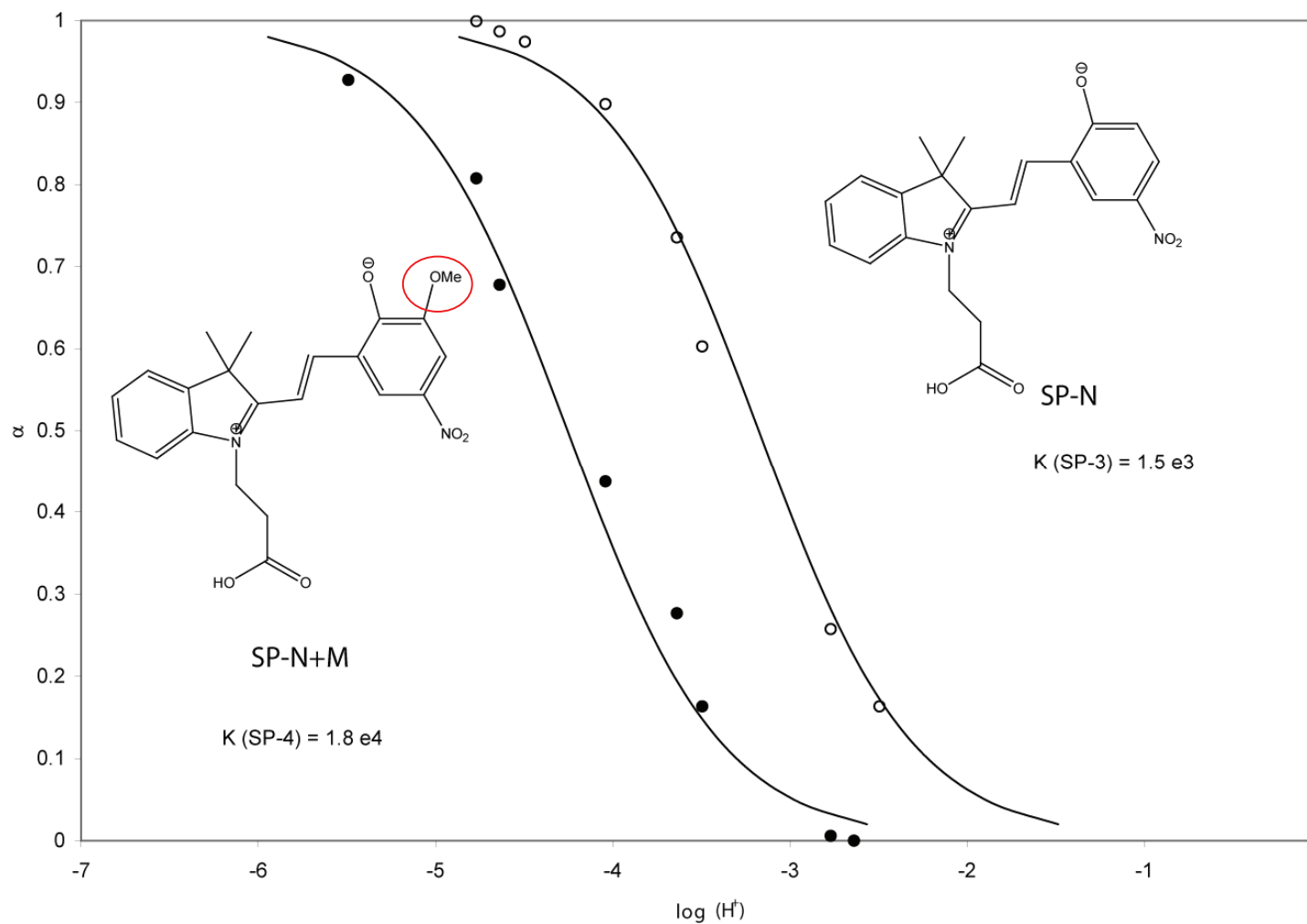


# Molecular modelling

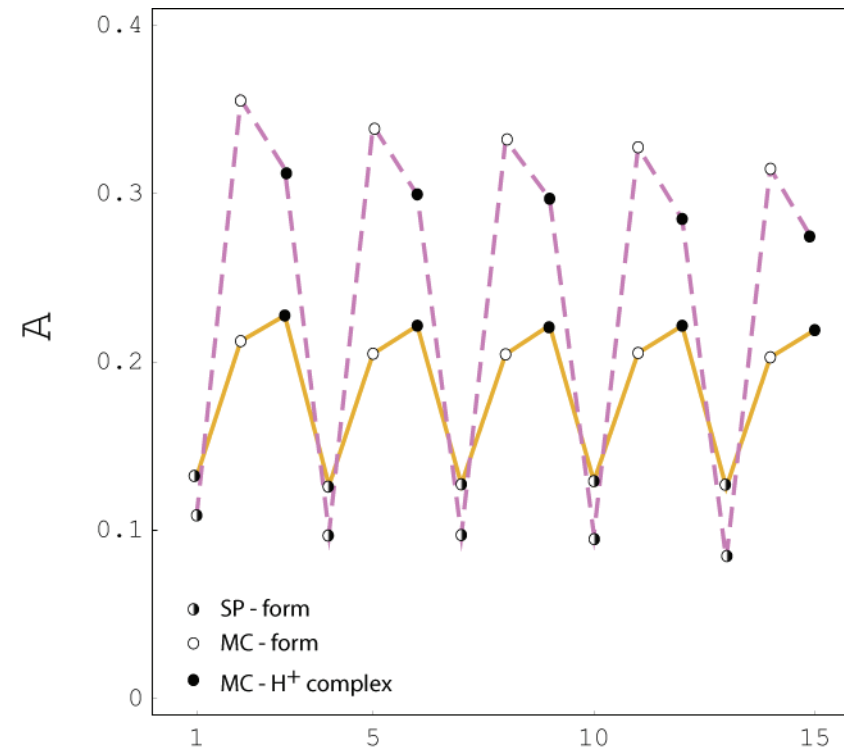
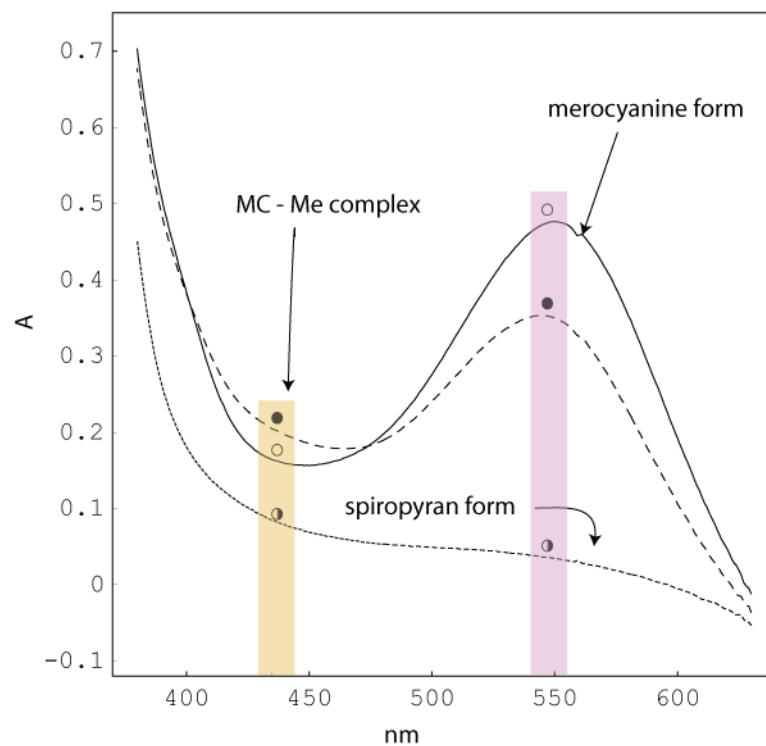


B3LYP/6-31G(d)

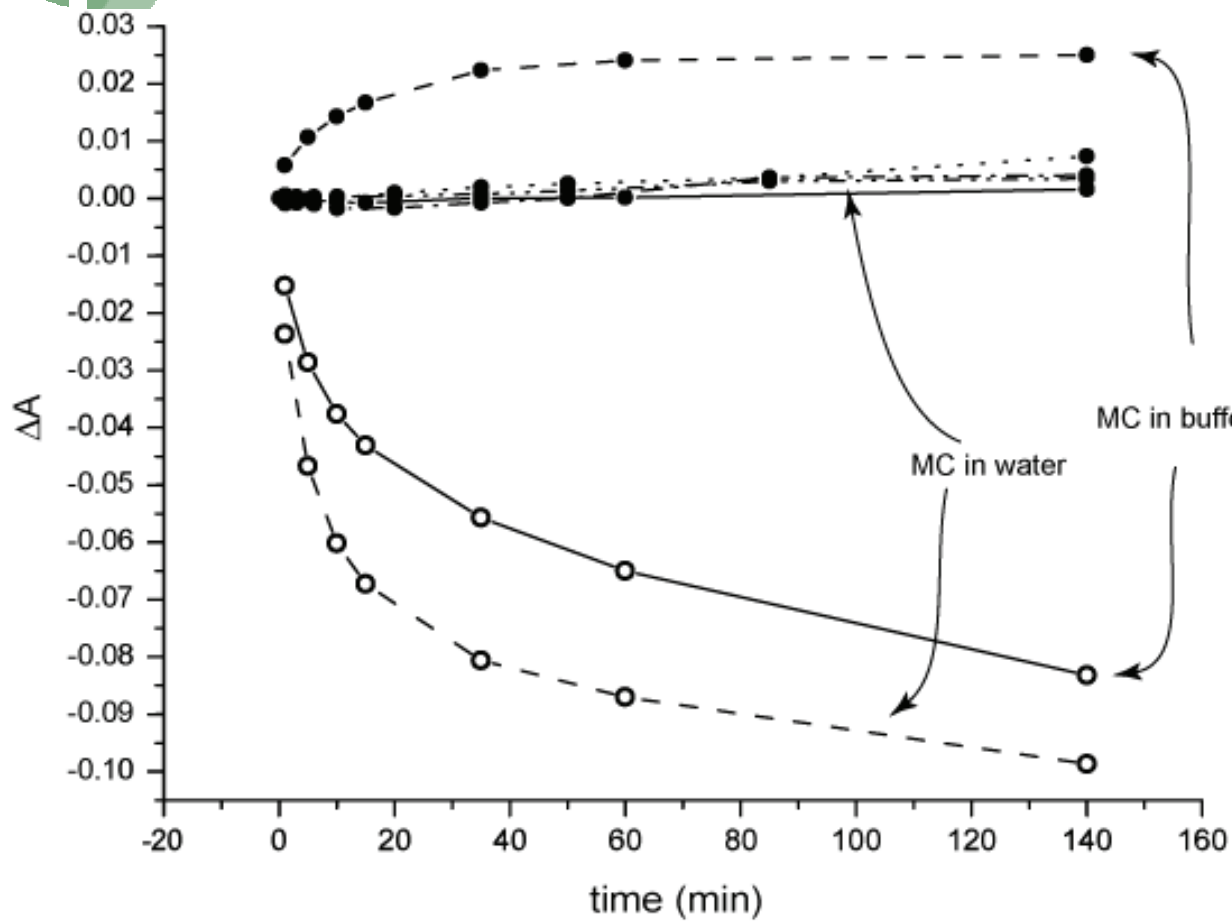
# Sensitivity



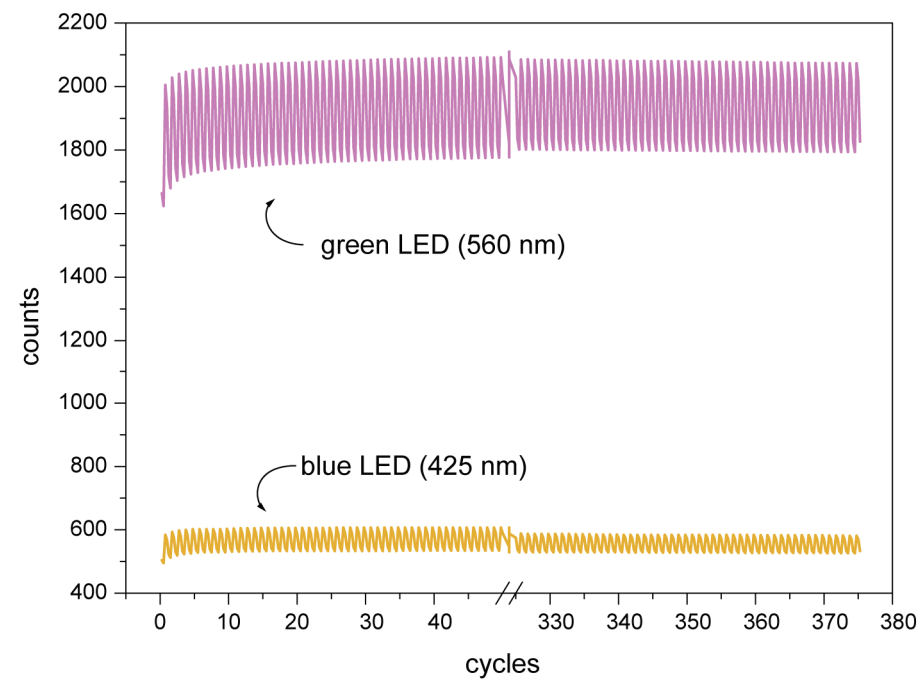
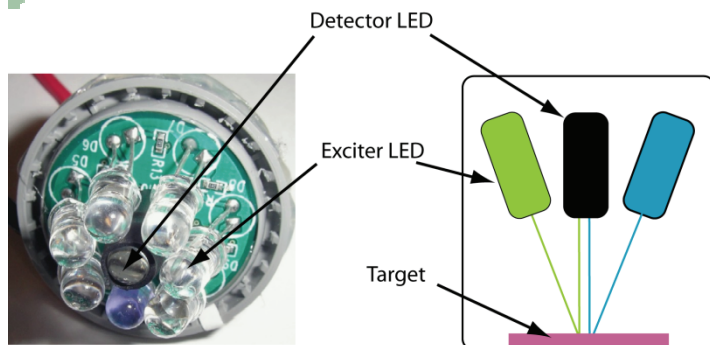
# Photoreversible, user-controlled ion detection



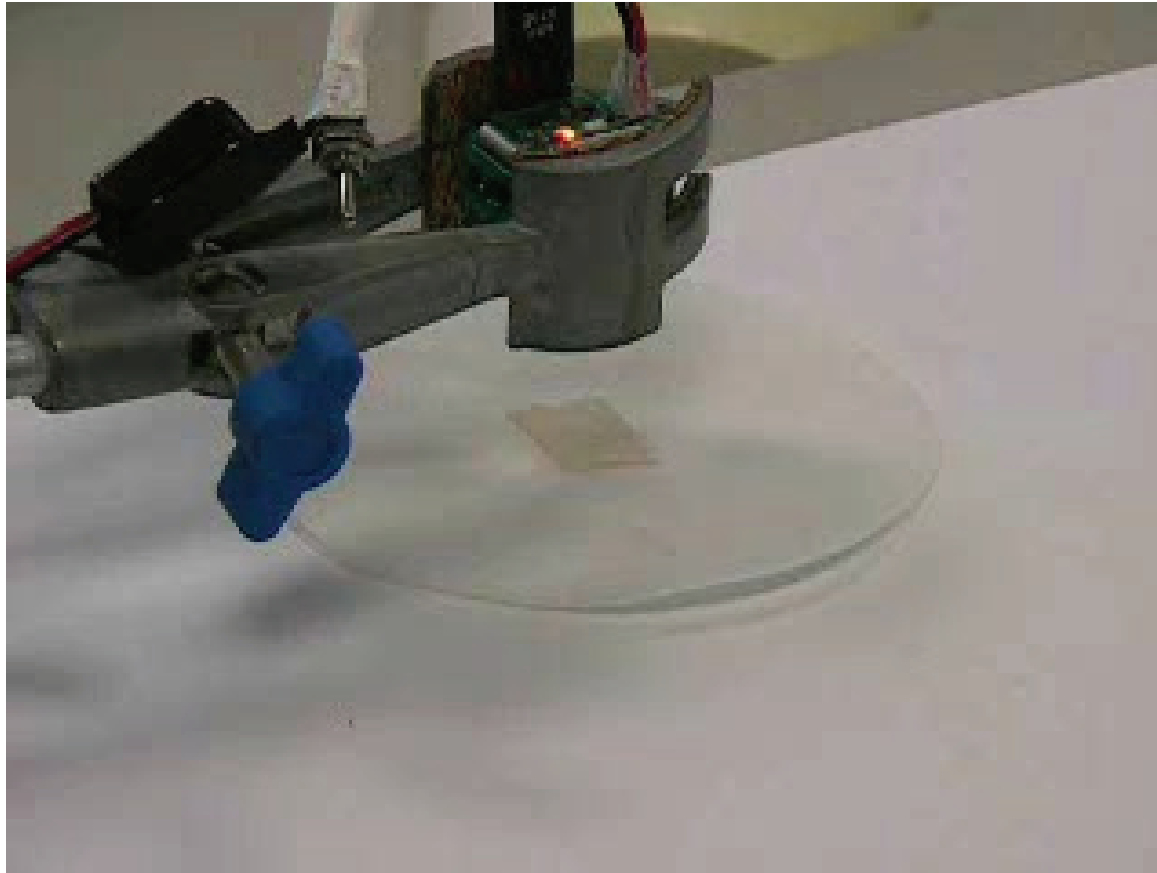
# Time response



# LED-based detection



# 'Disco' photometer



# Conclusions

- Reducing the need for sensor calibration will open up many new application areas
- Surface immobilization of spiropyran reduces its photodegradation
- Derivatization of spiropyran to include new binding centres improves its sensitivity
- Reversible, user-controlled, light-modulated sensing demonstrated
- LED-based photometer is an excellent platform for low-cost optical sensing



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