Reversible photochromic polynorbornenes bearing spiropyran side groups for layer-by-layer coatings

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Cimtec 2014 – 6th Forum on New Materials

Outline

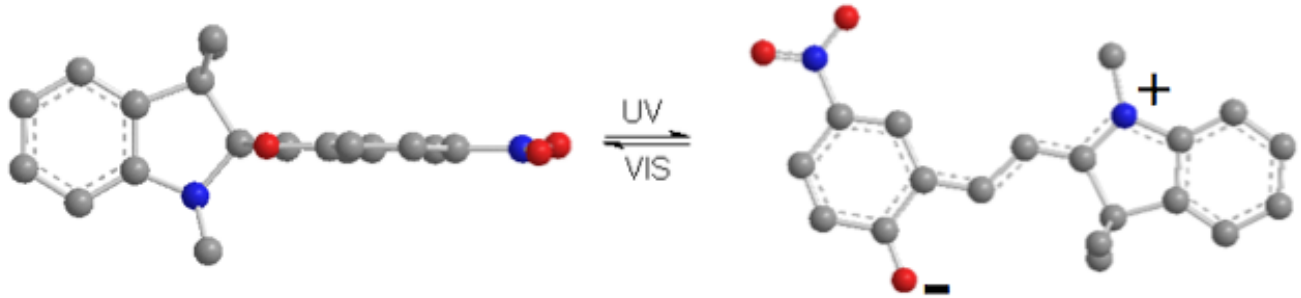
Background

Photochromic polynorbornenes bearing spiropyran side groups

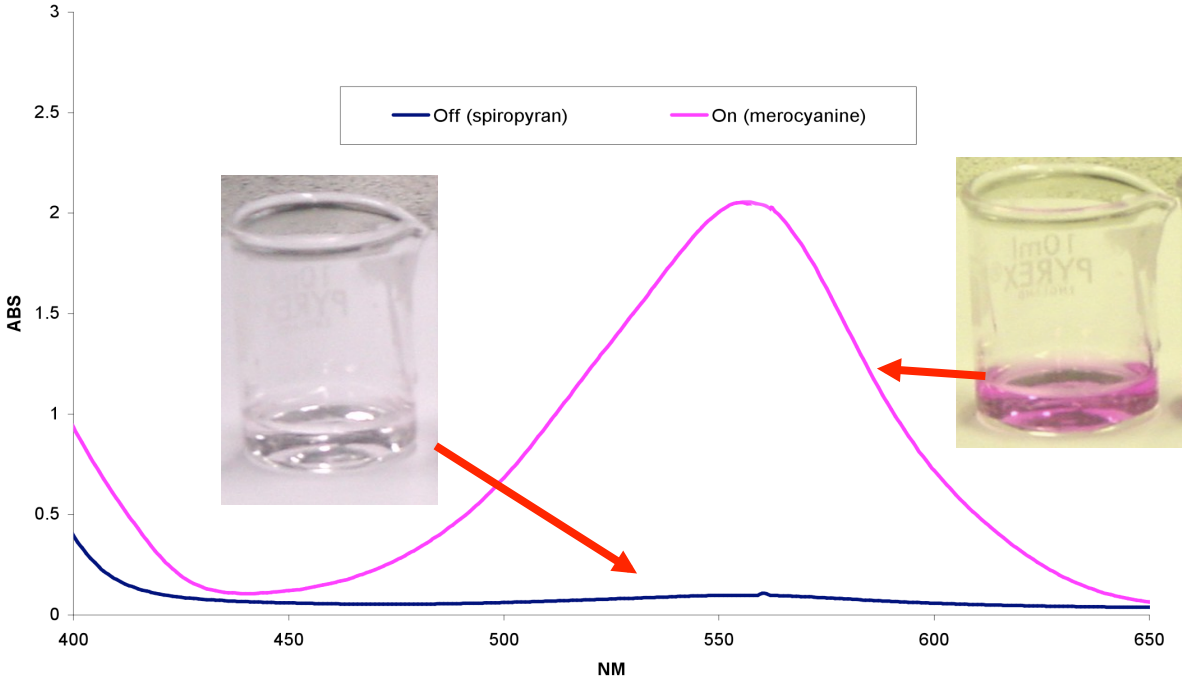
- Spiropyran norbornene monomer
- Spiropyran polynorbornene
- Characterisation
- LbL assembly
- Photo-induced dissasembly
- Photo-responsive drug delivery capsules

Conclusions

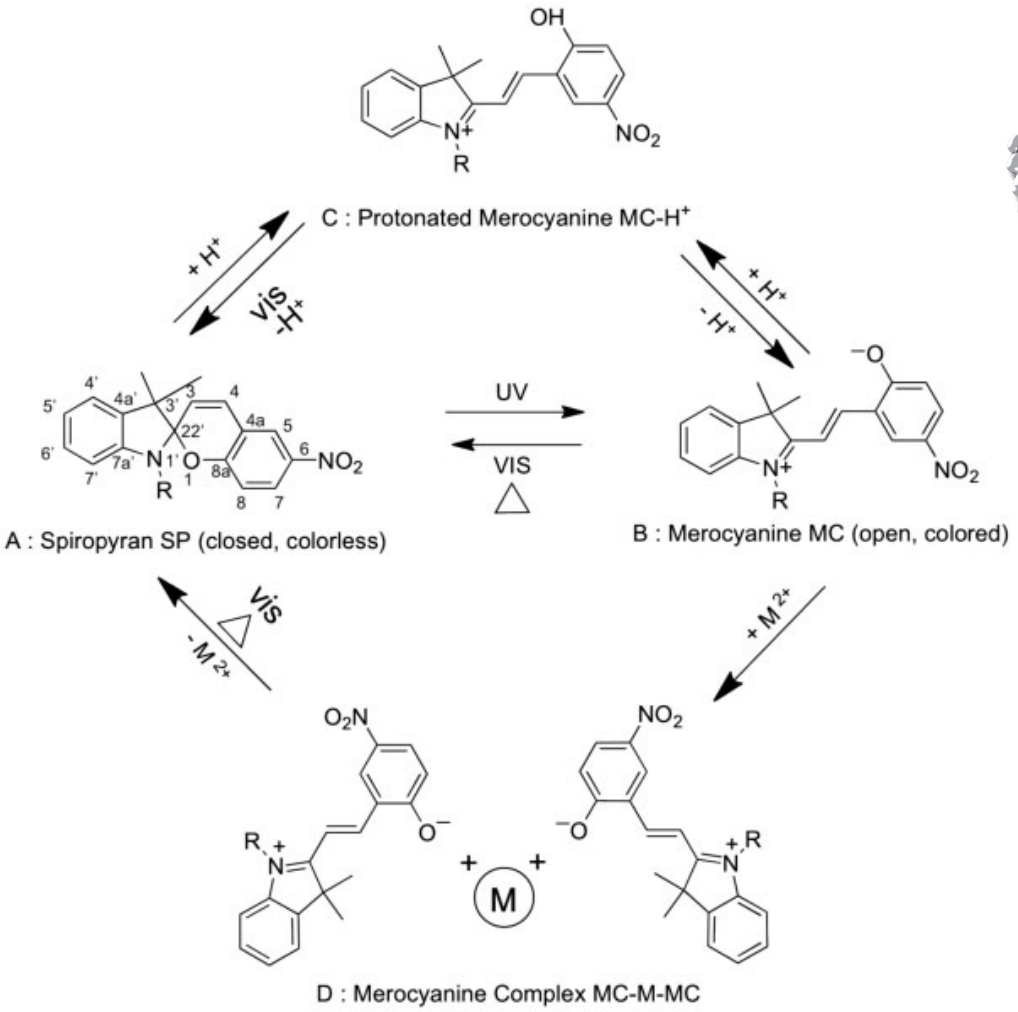
Spiropyrans



A : Spiropyran SP (closed, colorless) **B : Merocyanine MC (open, colored)**



Spiropyrans



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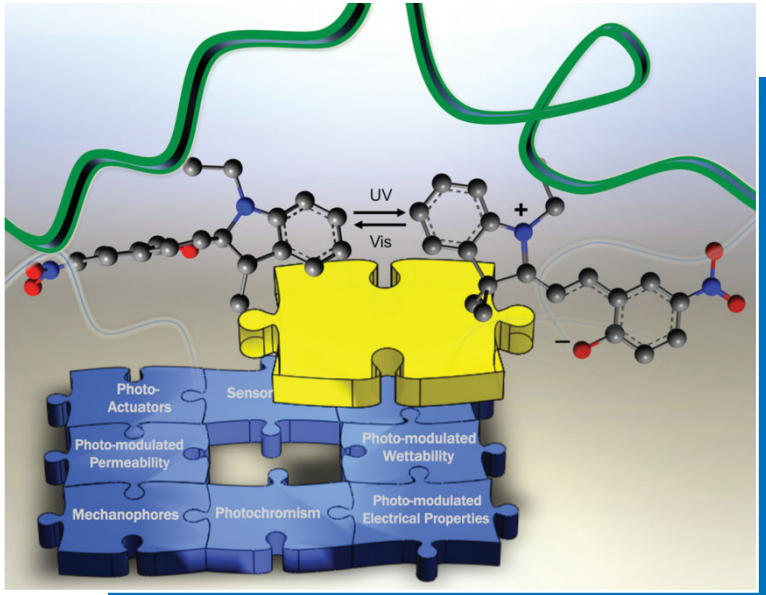
Macromolecular Materials and Engineering



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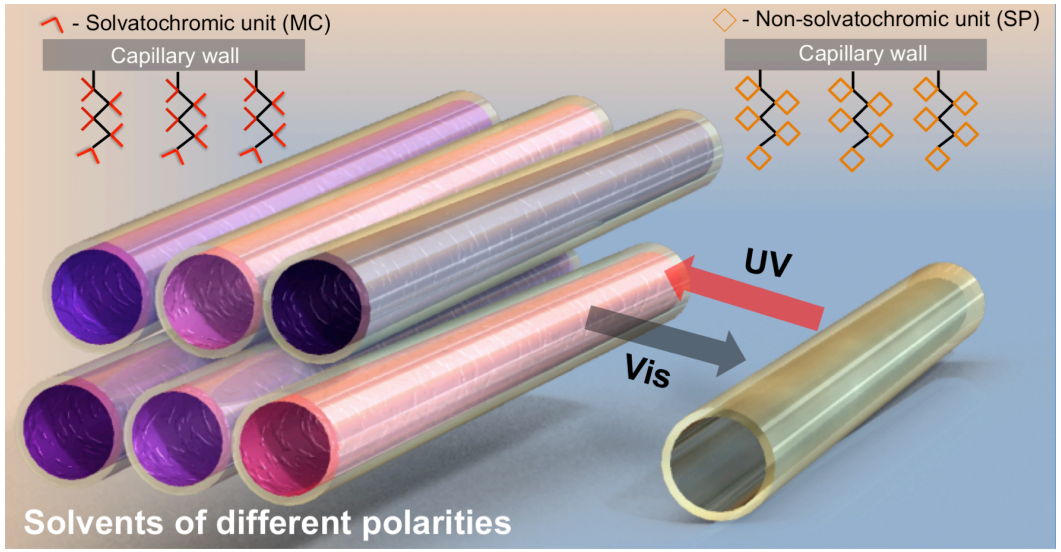
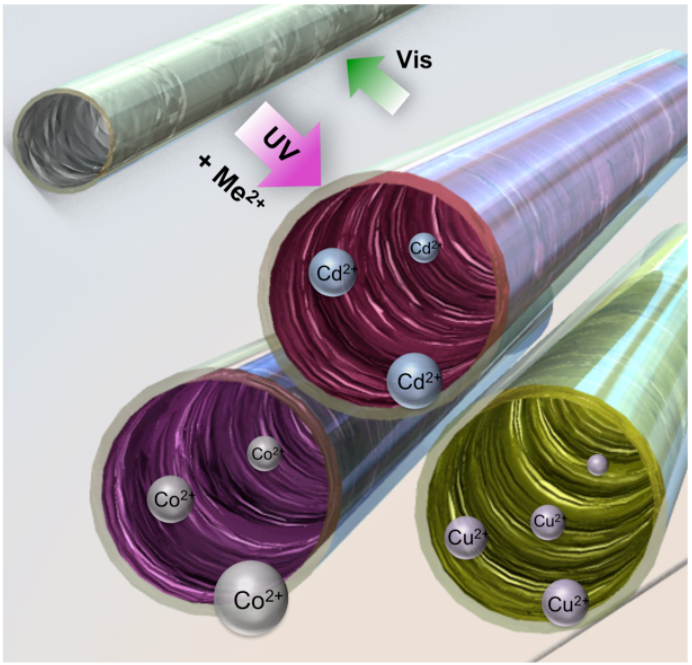
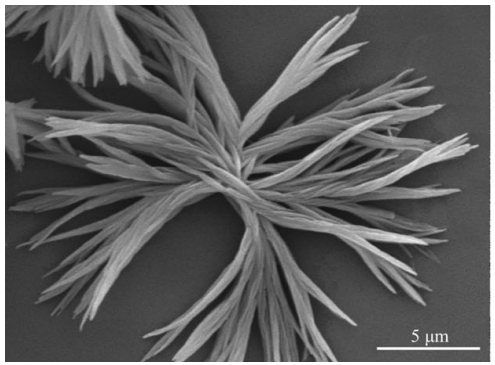
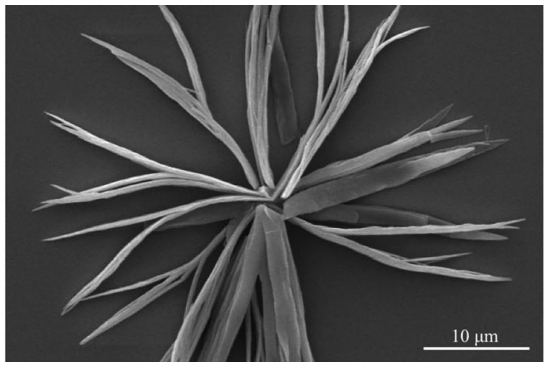
L. Florea, D. Diamond and F. Benito-Lopez, *Macromolecular Materials and Engineering*, 2012, 297, 1148-1159.

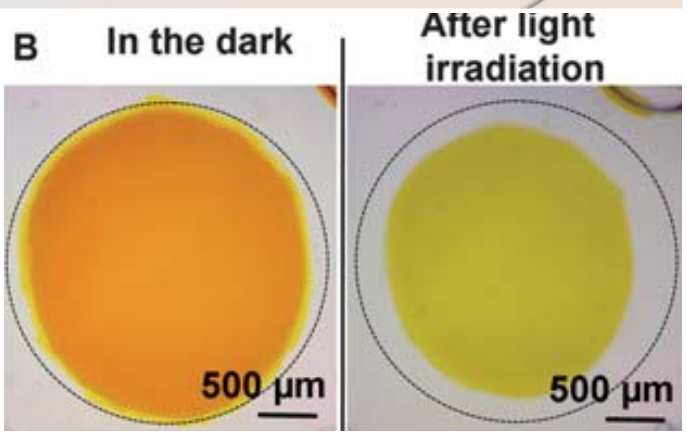
Spiropyrans











L. Florea, S. Scarmagnani, F. Benito-Lopez, D. Diamond *ChemComm*. 2014.

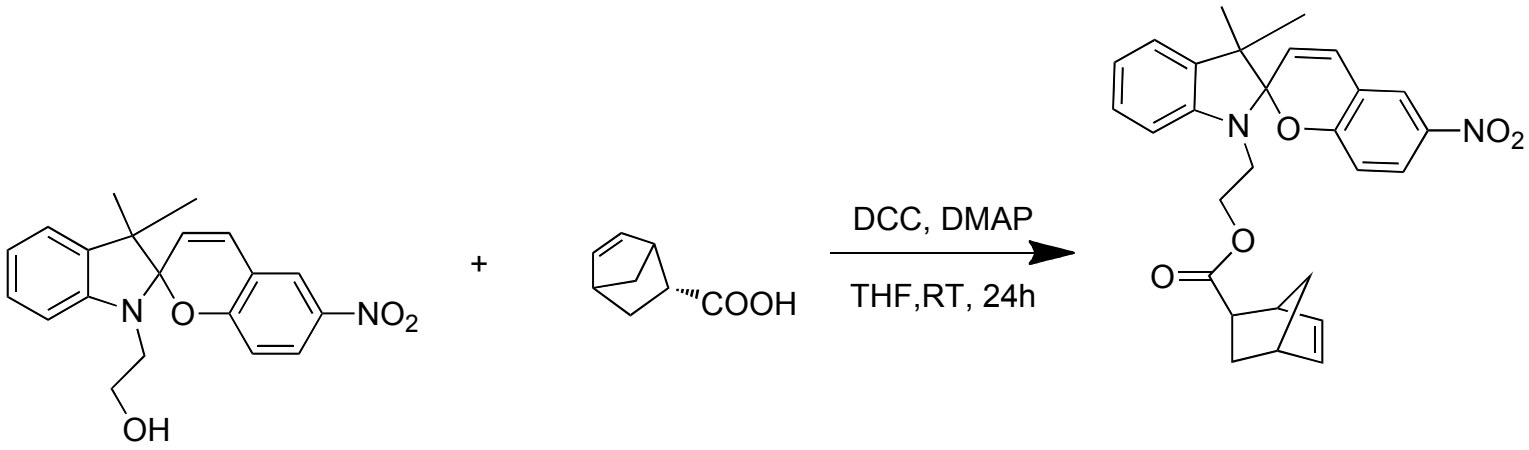
B. Ziolkowski, L. Florea, J. Theobald, F. Benito-Lopez and D. Diamond, *Soft Matter*, 2013, 9, 8754-8760.

L. Florea, A. Hennart, D. Diamond and F. Benito-Lopez, *Sens. Actuators B: Chem.*, 2012, 175, 92-99.

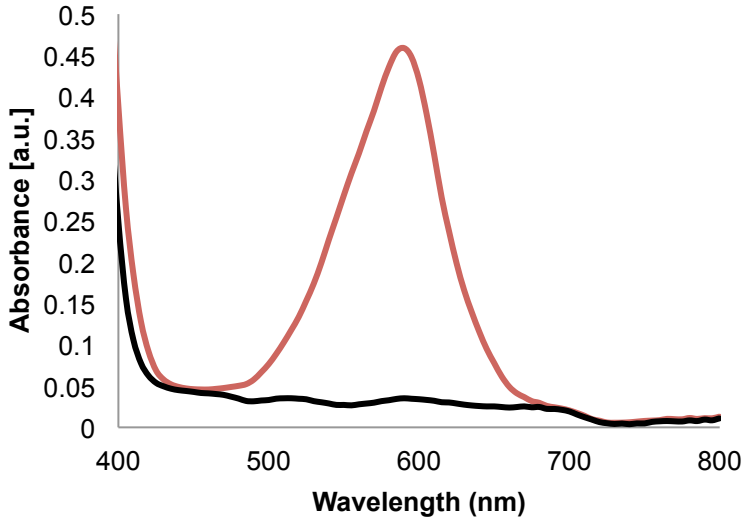
L. Florea, A. McKeon, D. Diamond and F. Benito-Lopez, *Langmuir*, 2013, 29, 2790-2797.

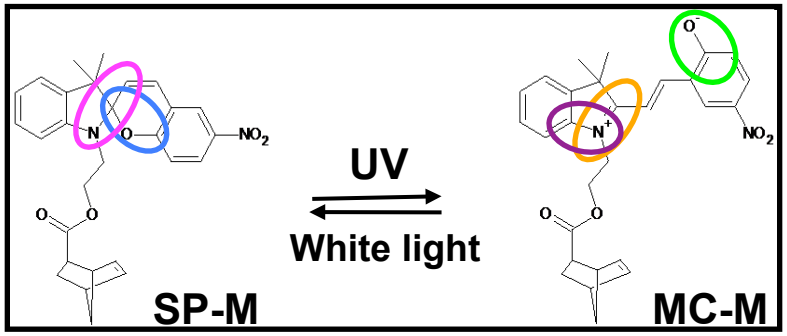
Photo-responsive polymers

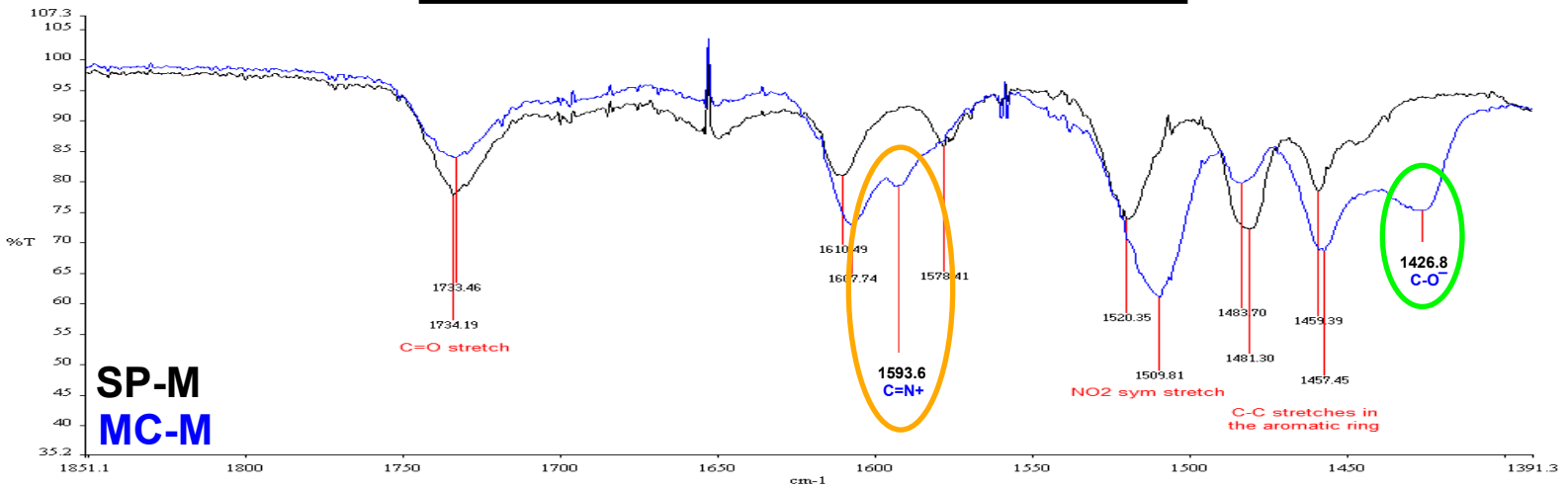
➢ Spiropyran norbornene monomer

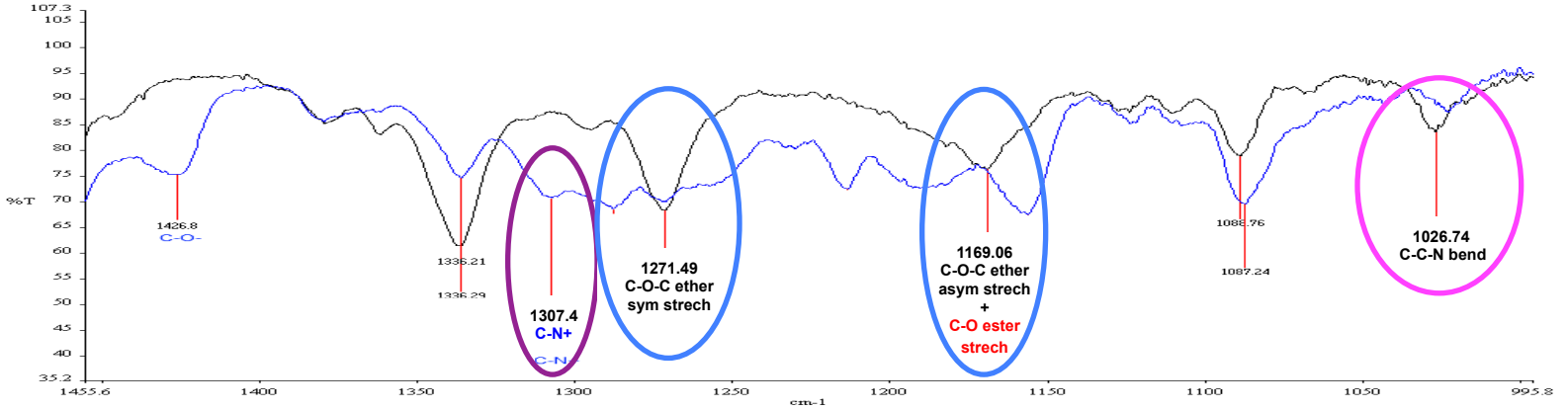


SP **SP-M**

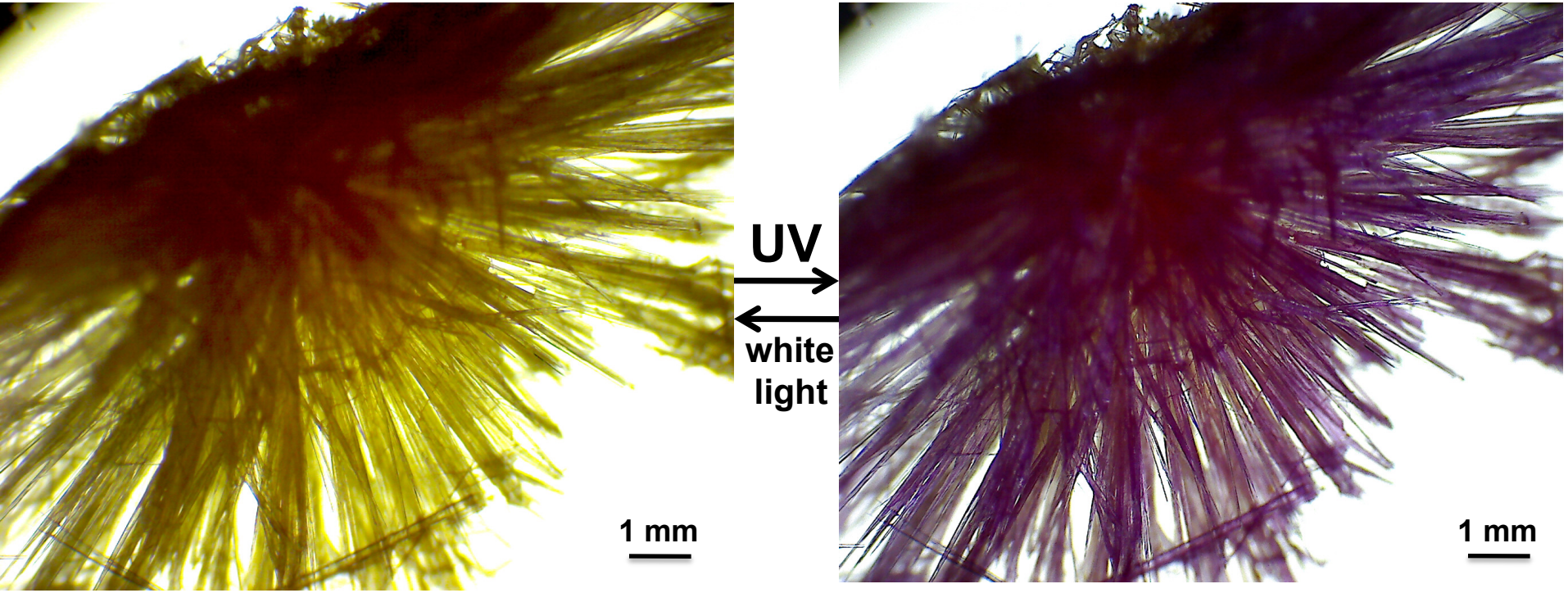



UV
White light
SP-M
MC-M


SP-M
MC-M
%T
cm-1
1733.46
1734.19
C=O stretch
1610.49
1607.74
1578.41
1593.6
C=N+
1520.35
1509.81
NO2 sym stretch
1483.70
1481.30
1459.39
1457.45
C-C stretches in the aromatic ring
1426.8
C-O⁻


%T
cm-1
1426.8
C-O⁻
1336.21
1336.29
1307.4
C-N+
1271.49
C-O-C ether
sym strech
1169.06
C-O-C ether
asym strech
+
C-O ester
strech
1088.76
1087.24
1026.74
C-C-N bend

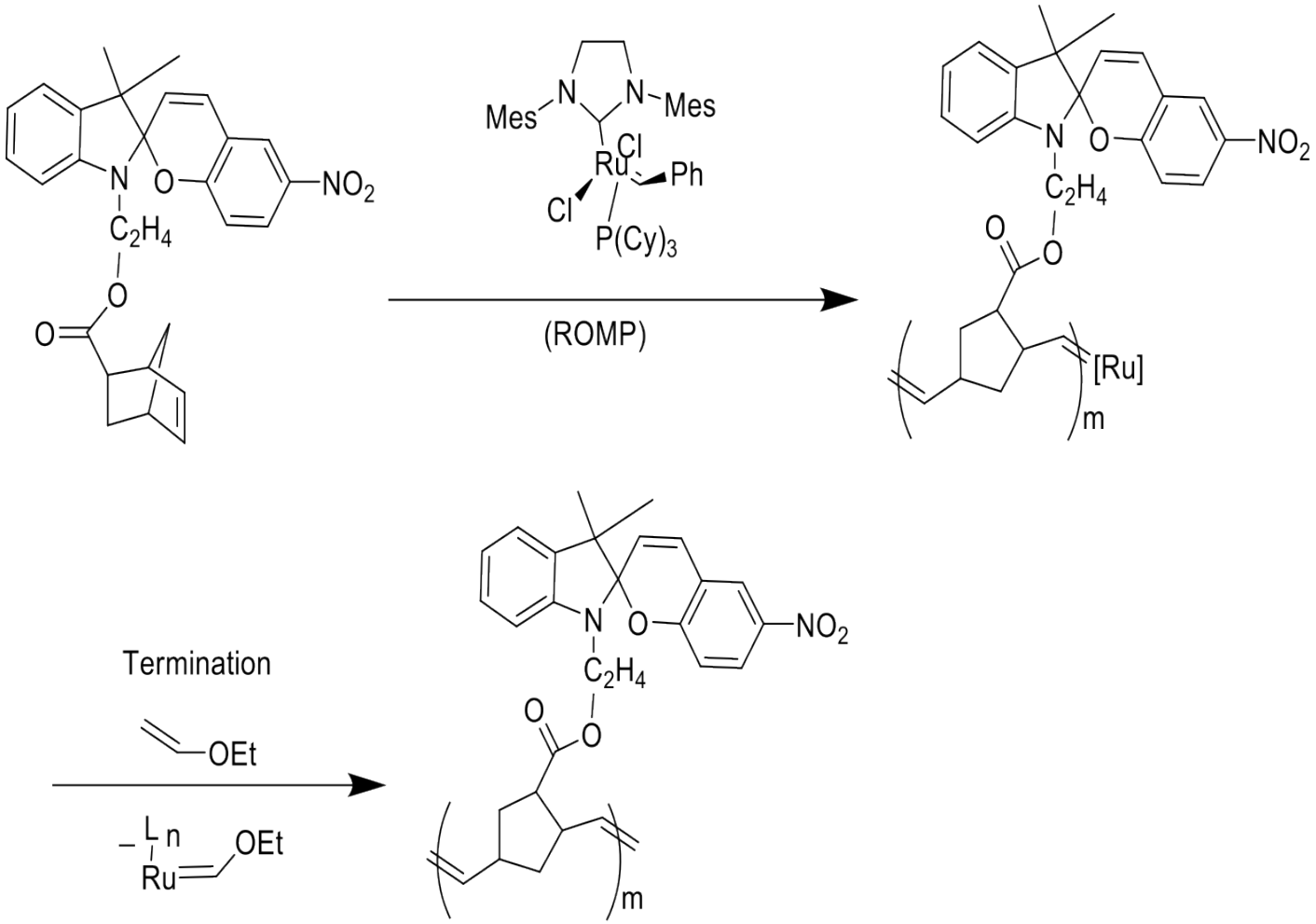
➢ Spiropyran norbornene monomer



➢ Spiropyran norbornene monomer

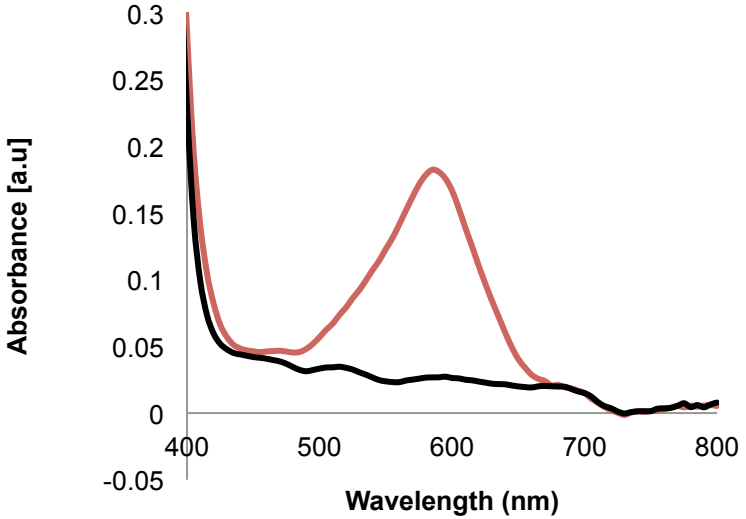
Polymerisation of Spiropyran Monomer

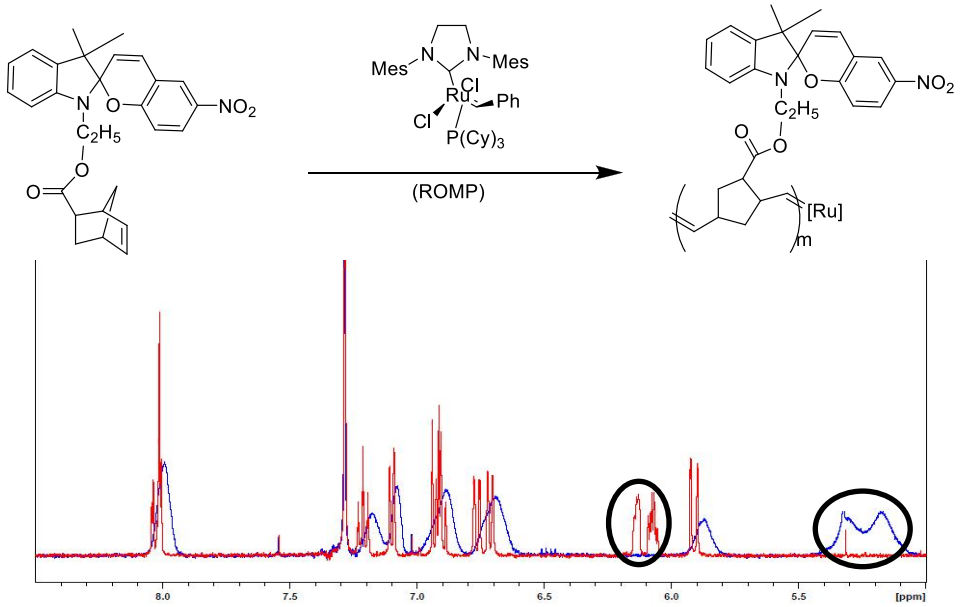
- **Ring-opening metathesis polymerisation**

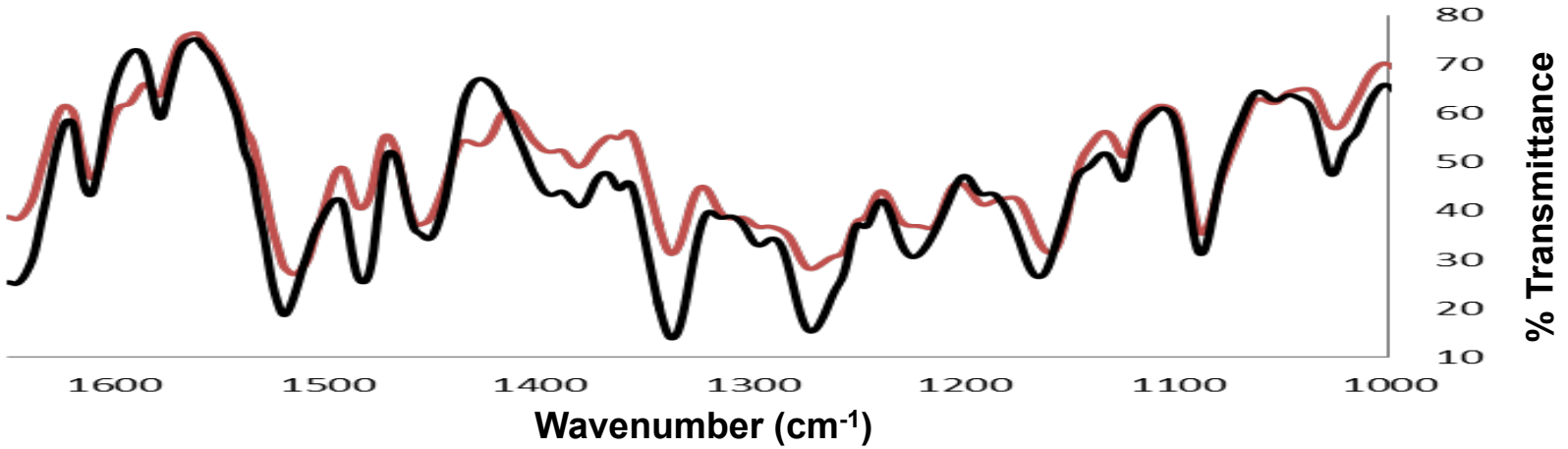


m=80,100,300

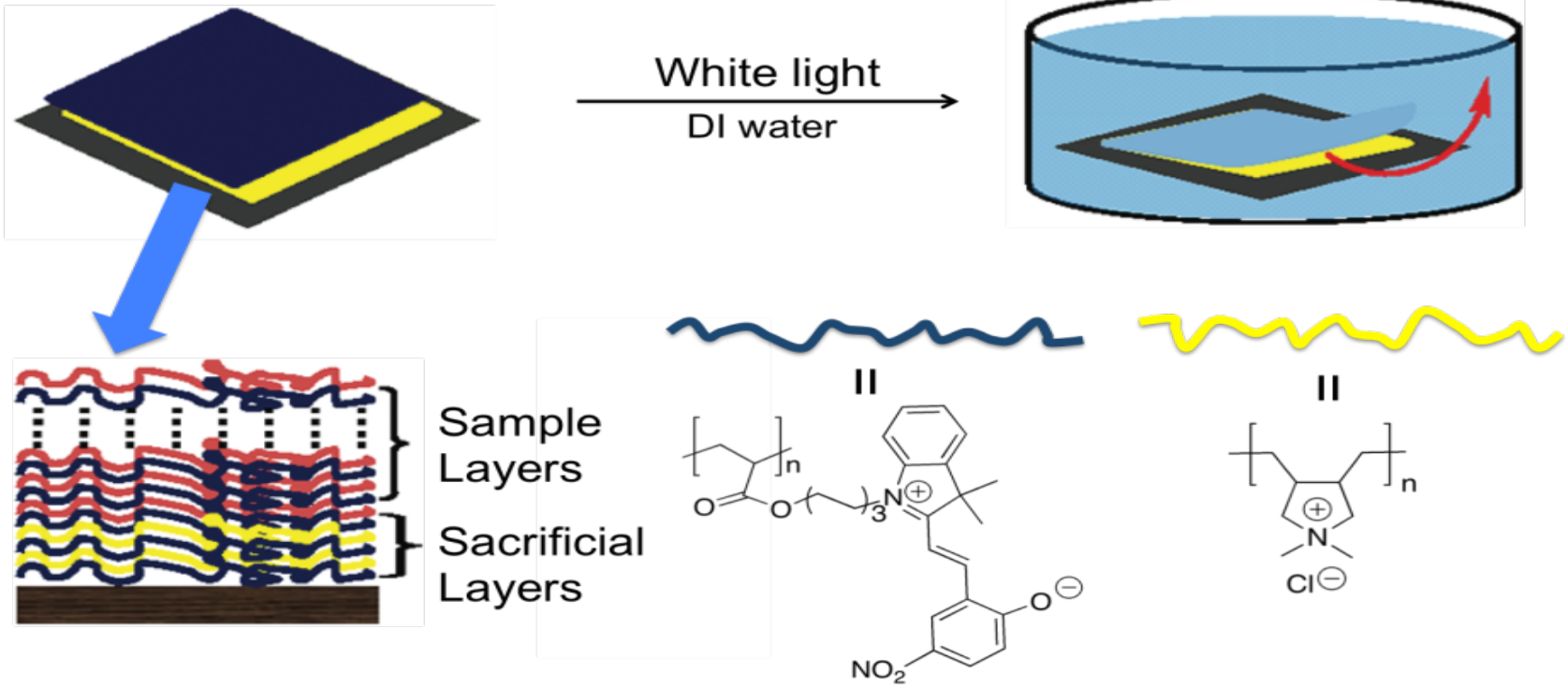
Polymer Characterisation





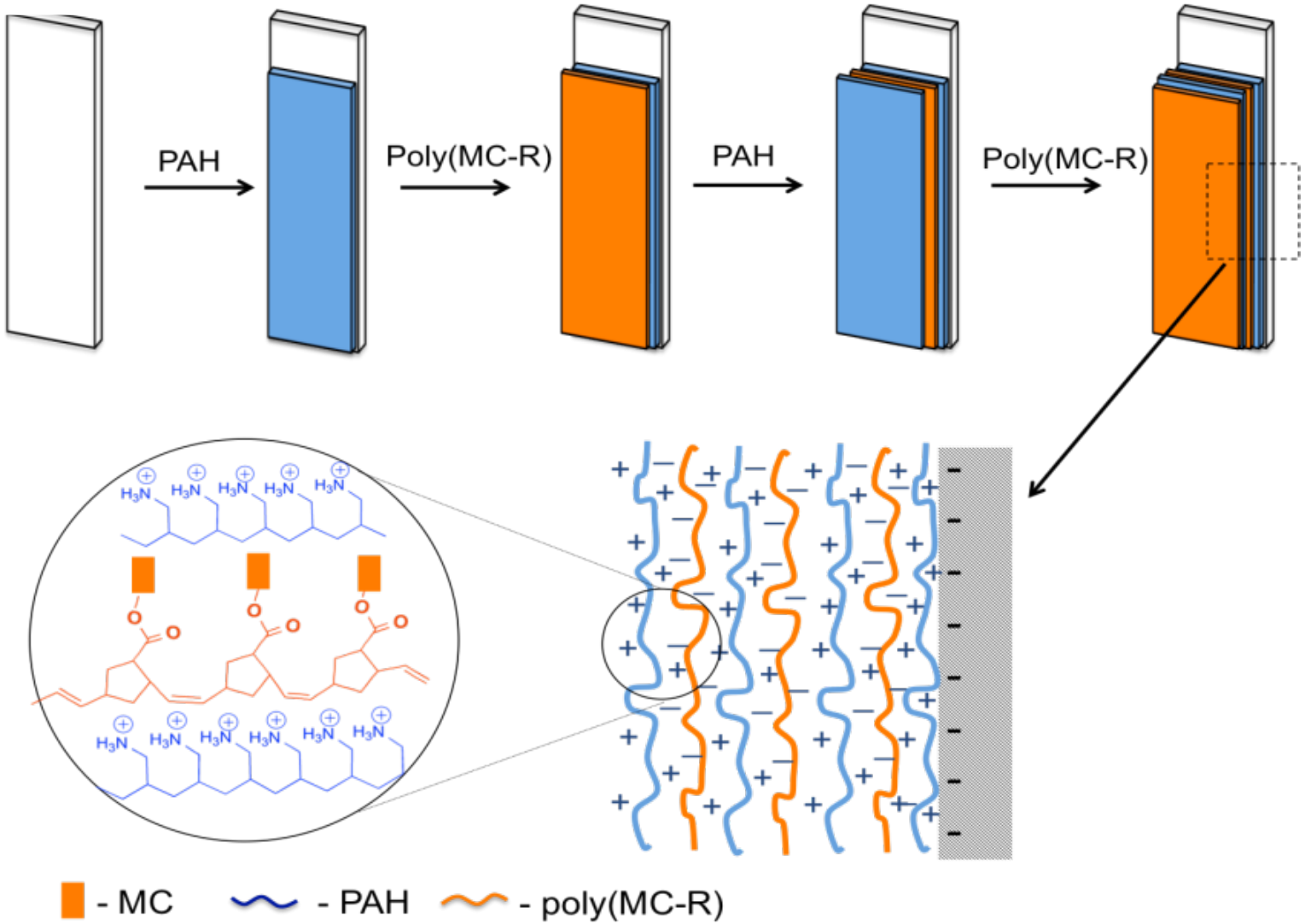


Merocyanine polymers for LbL coatings

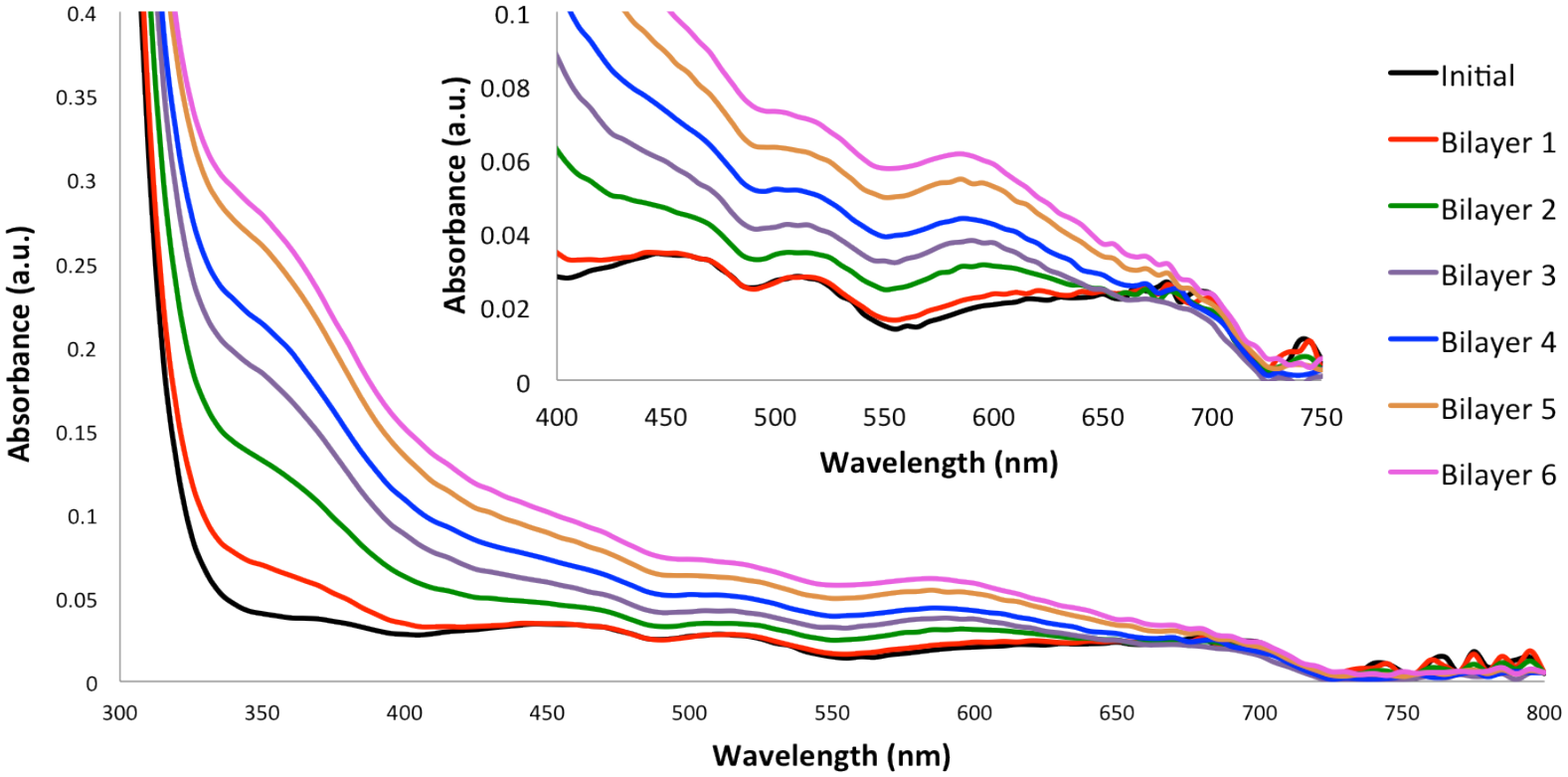


Pennakalathil, J.; Hong, J.-D., *Acs Nano* 2011, *5*, 9232-9237.

LbL coatings

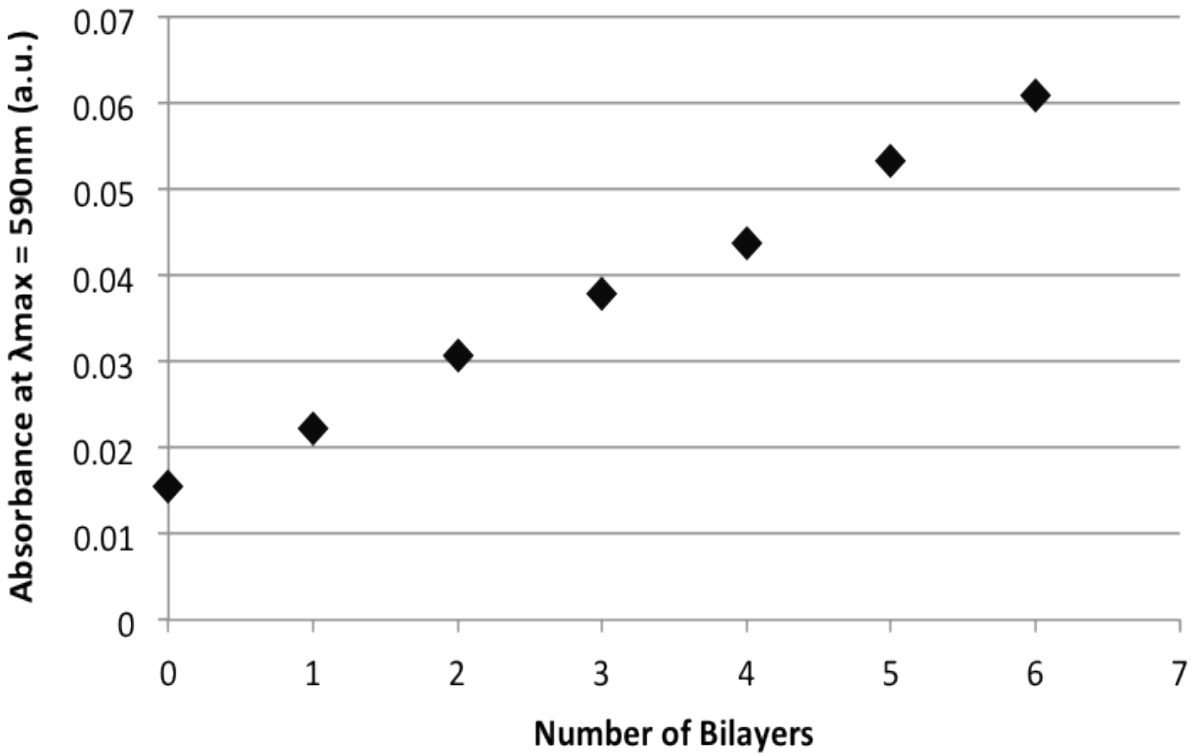


LbL coatings

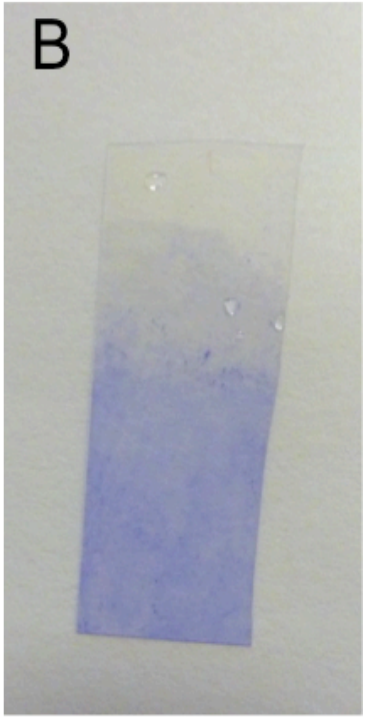


LbL coatings

A

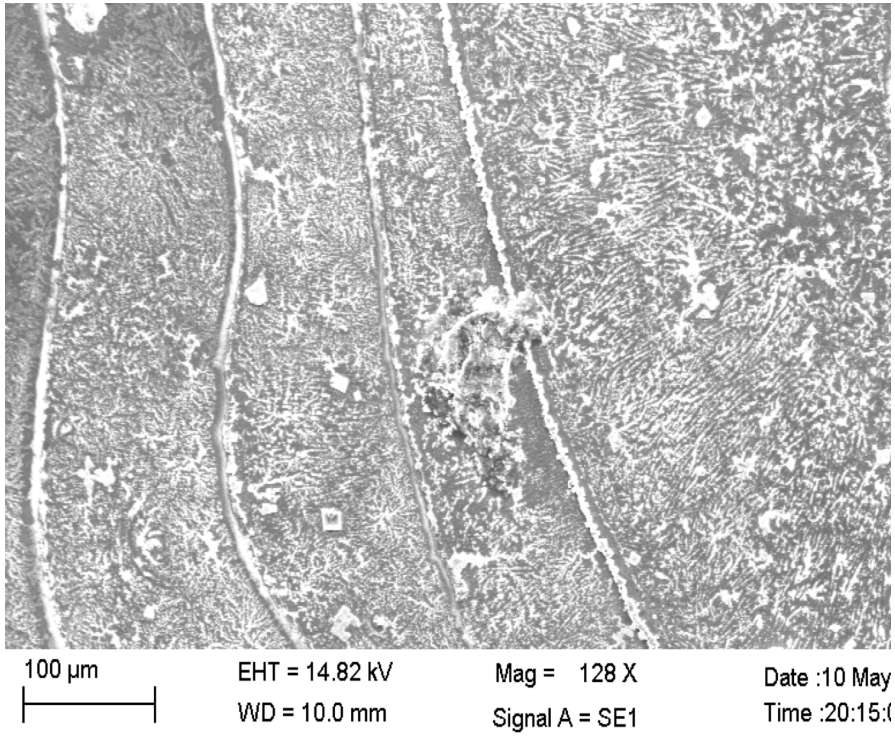


B



LbL coatings

➢ SEM imaging



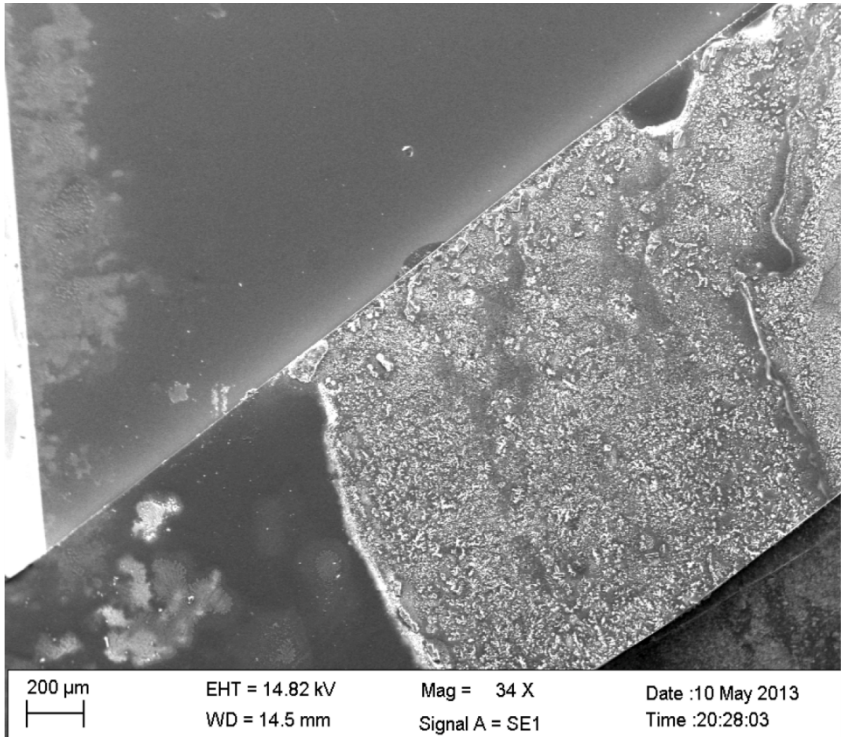
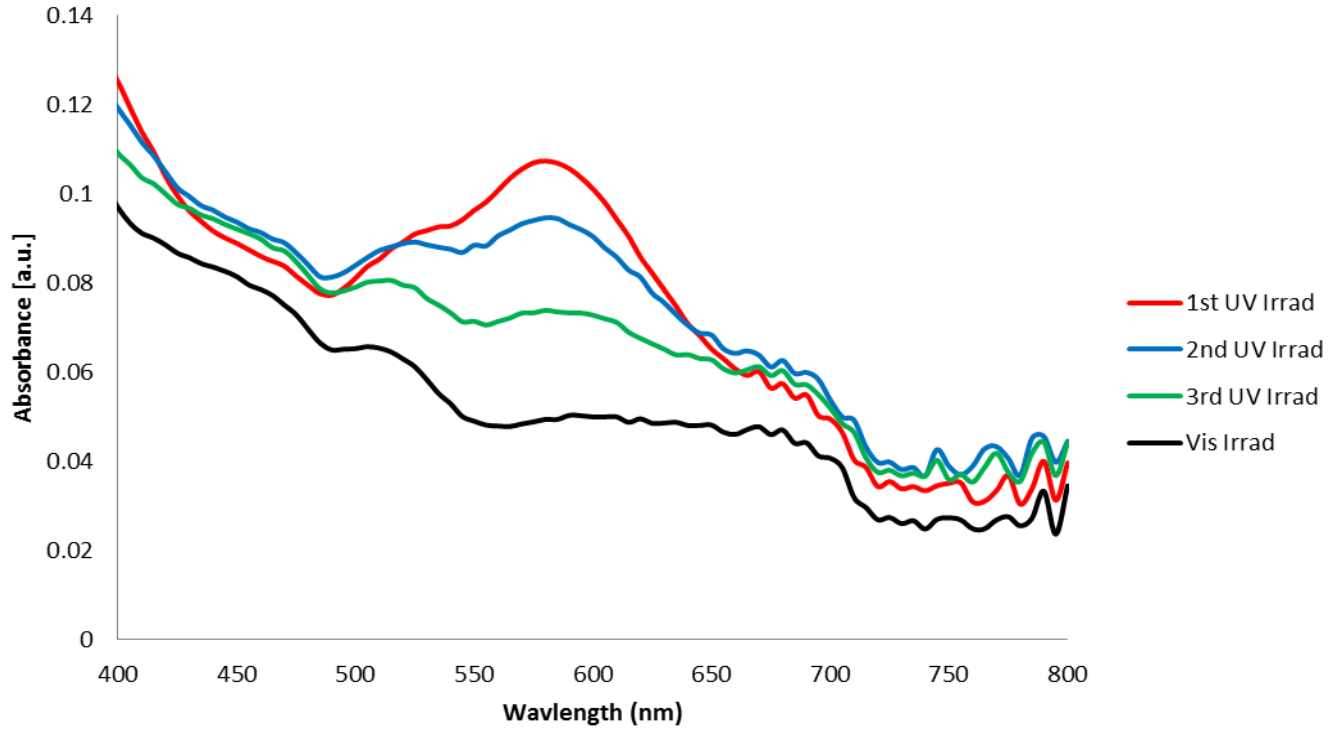


Photo-induced dissasembly

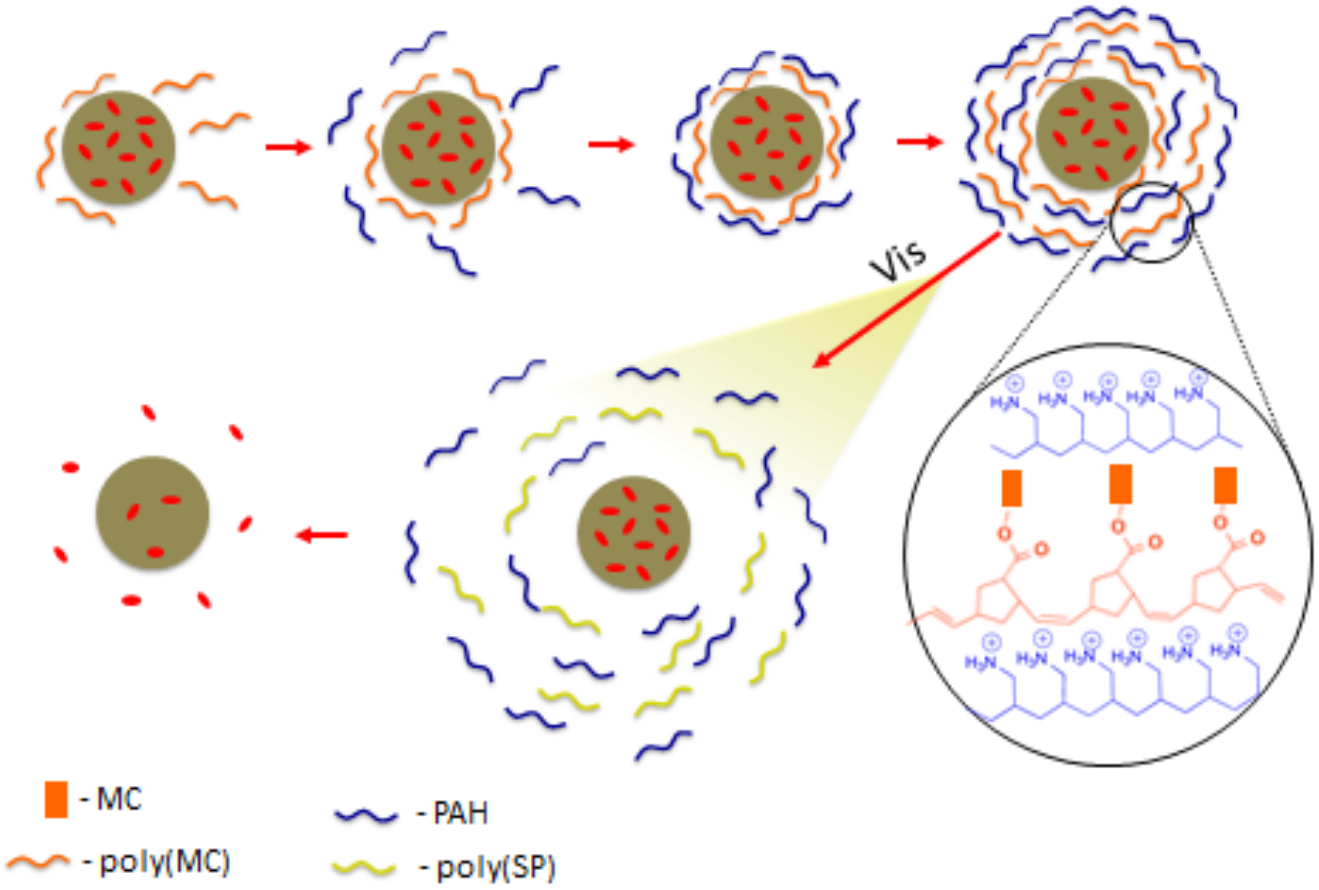
- **Absorbance at 590nm decreases by 60% under white light irradiation**



Conclusions

- Synthesised a new polynorbornene spiropyran polymer.
- Characterised spiropyran monomer and polymer.
- Developed new layer-by-layer coatings which disassemble under white light irradiation.

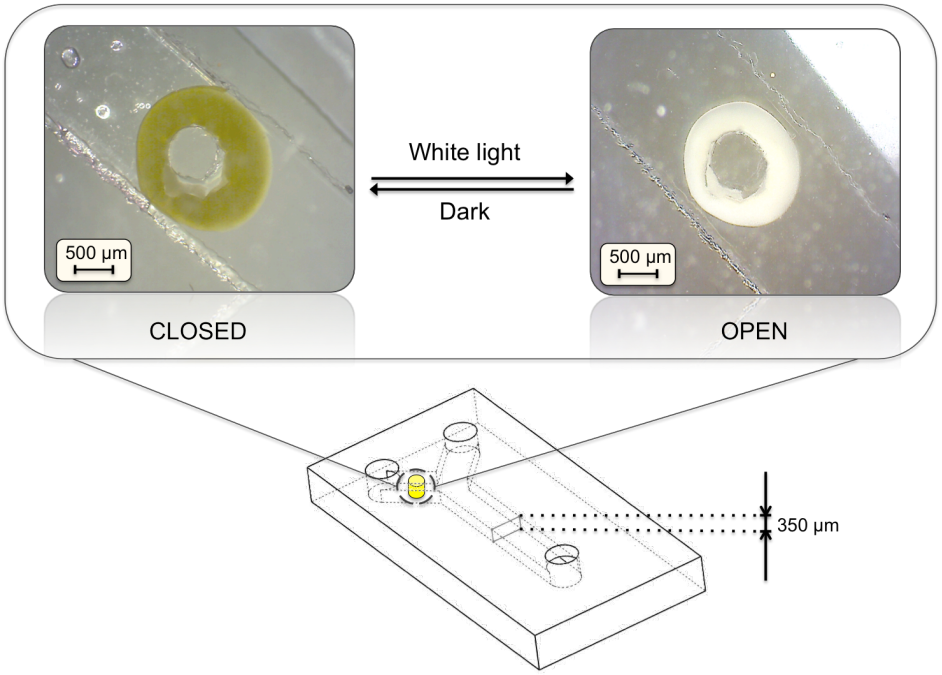
- **Development of photo-responsive drug delivery capsules**



FO : MEDICAL APPLICATIONS OF NOVEL BIOMATERIALS AND NANO-BIOTECHNOLOGY

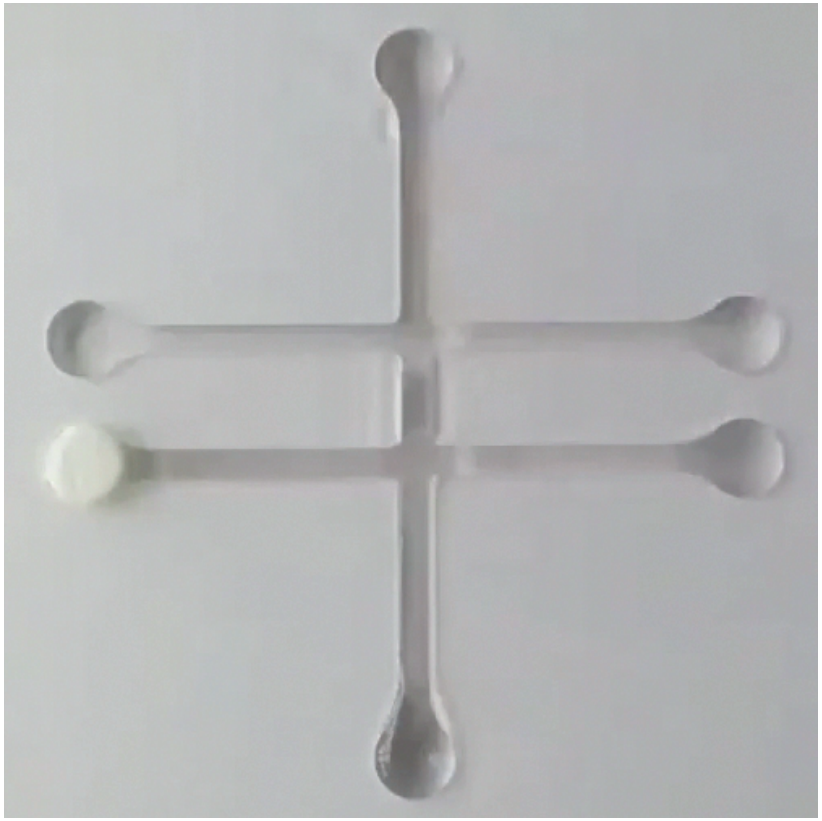
FO-8:P01 Photo-responsive Soft Actuators based on Spiropyran Functionalised hydrogels

A. Dunne, L. Florea, D. Diamond



FO-8:P09 Stimuli-controlled Movement of Droplets and Polymeric "Vehicles"

W. Francis, L. Florea, D. Diamond



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- Prof. Dermot Diamond
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Thank you!