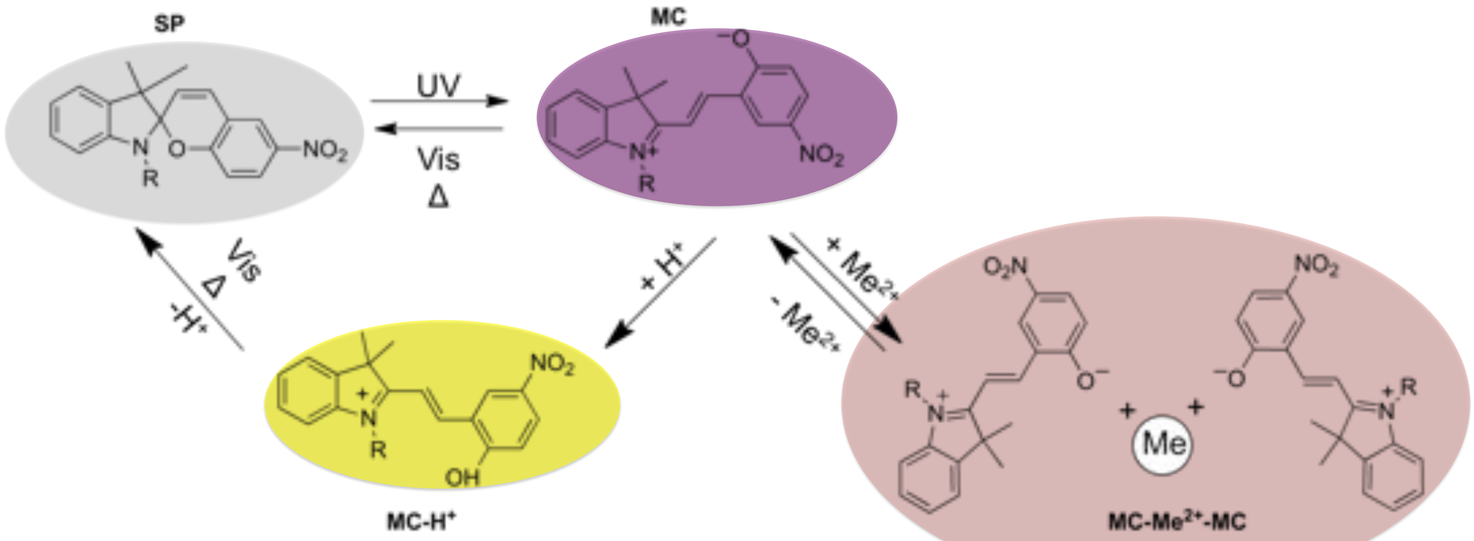
Multi-purpose capillary-integrated optical sensors based on spiropyran

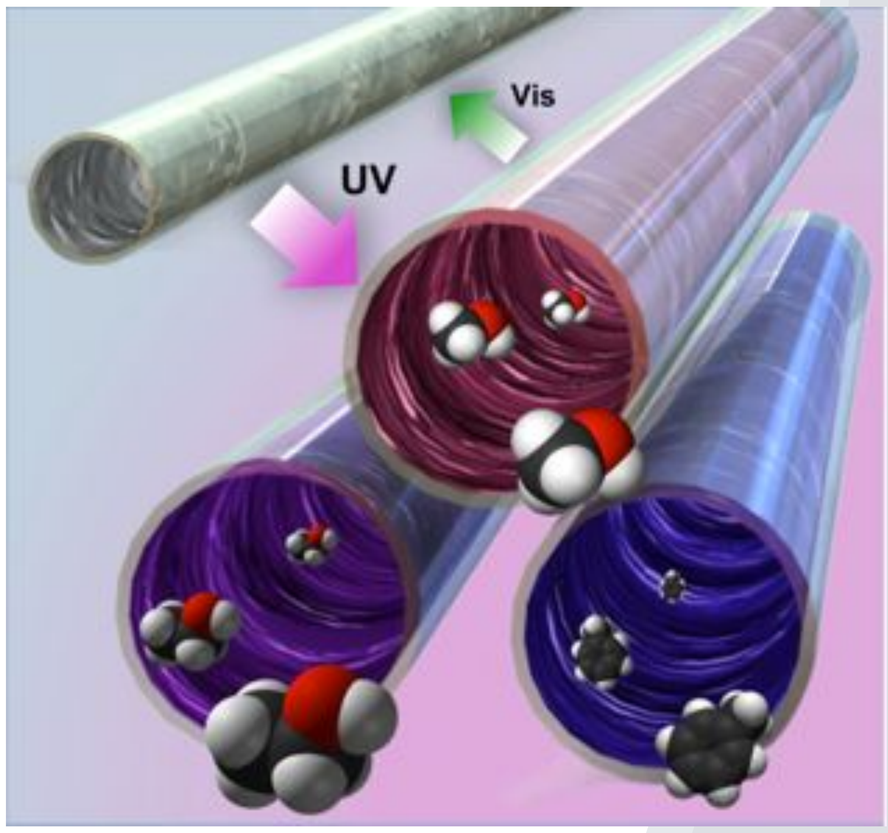
Larisa Florea[1], Fernando Benito-Lopez[1,2,*] and Dermot Diamond[1]

[1]CLARITY: Centre for Sensor Web Technologies, National Centre for Sensor Research, School of Chemical Sciences Dublin City University, Dublin 9, Ireland, [2]CIC microGUNE, Arrasate-Mondragón, Spain

➢ Introduction

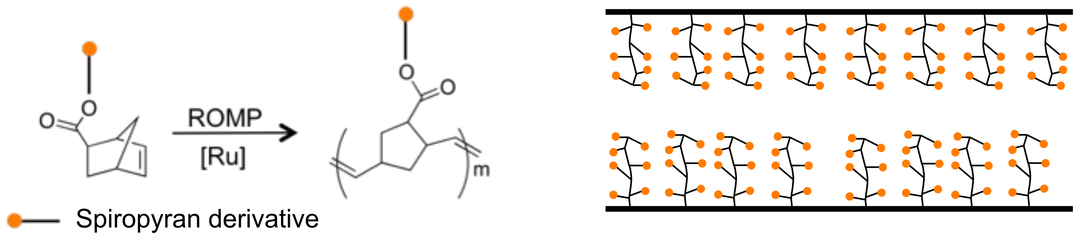
Here we present the functionalisation of the inner walls of micro-capillaries with polymeric coatings based on a spiropyran (SP) derivative and their successful use as capillary integrated optical sensors for a variety of target analytical species (divalent metal ions, solvents of different polarities, H^+). The polymeric brushes approach offers a nanostructured to microstructured responsive coating ensuring small diffusion paths and fast response times towards the target species. Moreover, this sensing behavior can be switched ON-OFF using light of appropriate wavelengths.

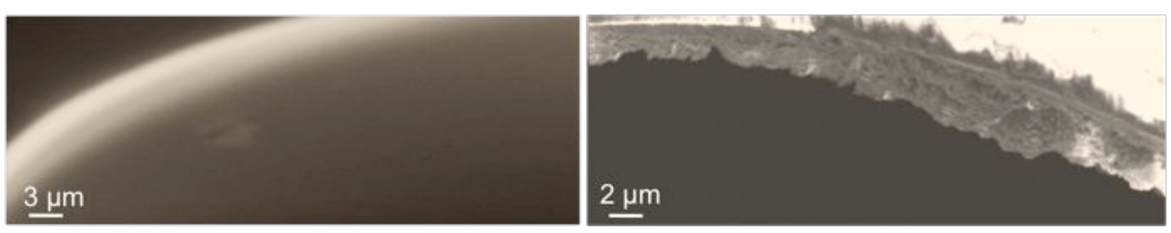




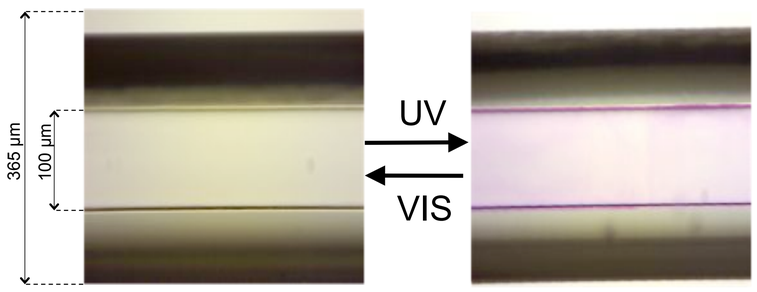
➢ Micro-capillary Functionalisation Process

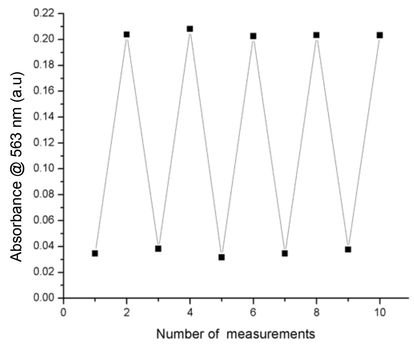
The inner walls of fused silica micro-capillaries were successfully coated with spiropyran polymeric brushes using surface-initiated ring-opening metathesis polymerisation [1]. Scanning Electron Microscopy imaging of the SP brushes inside the micro-capillary showed that coatings having lengths of about 2-3 µm were obtained.





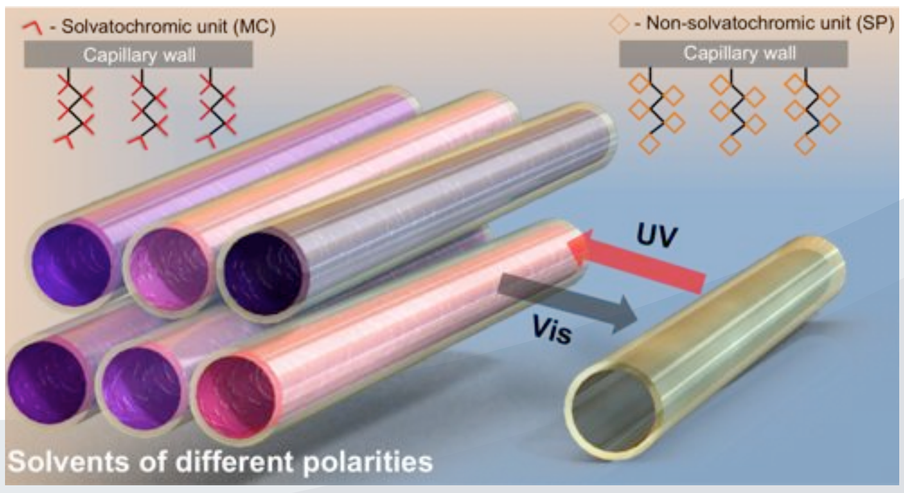
➢ Photochromic Performance

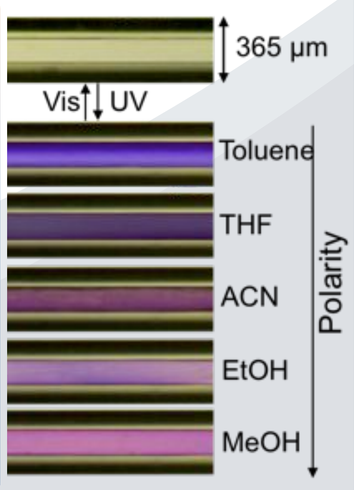




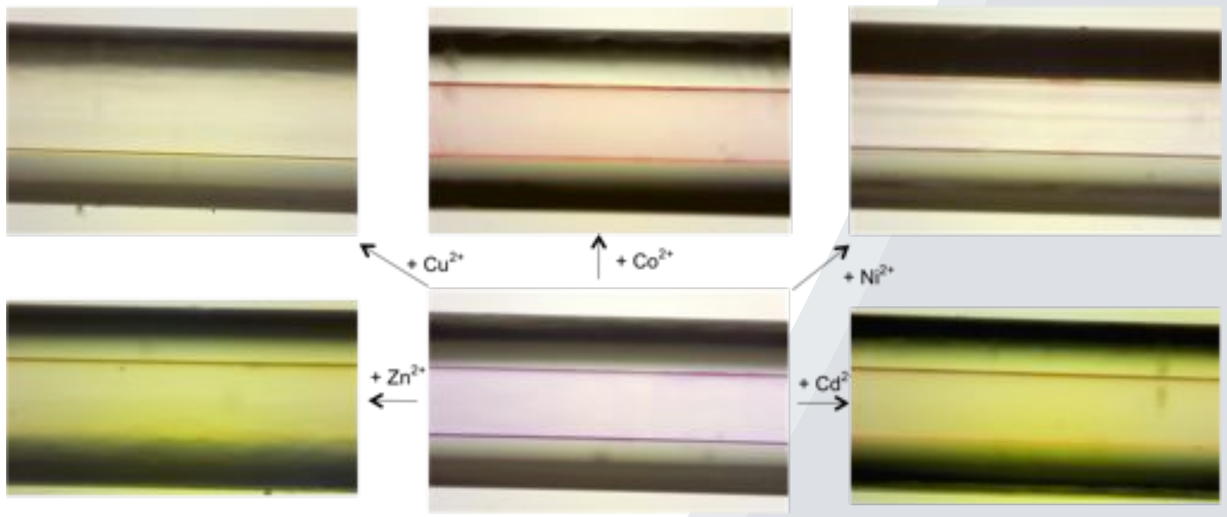
➢ Sensing Properties. 1. Solvent Sensing

Based on the inherited spiropyran properties, the functionalised capillaries were successfully used to photoidentify solvents of different polarity (toluene, tetrahydrofuran, acetone, acetonitrile, ethanol, and methanol) when passing through the micro-capillary in continuous flow [2].

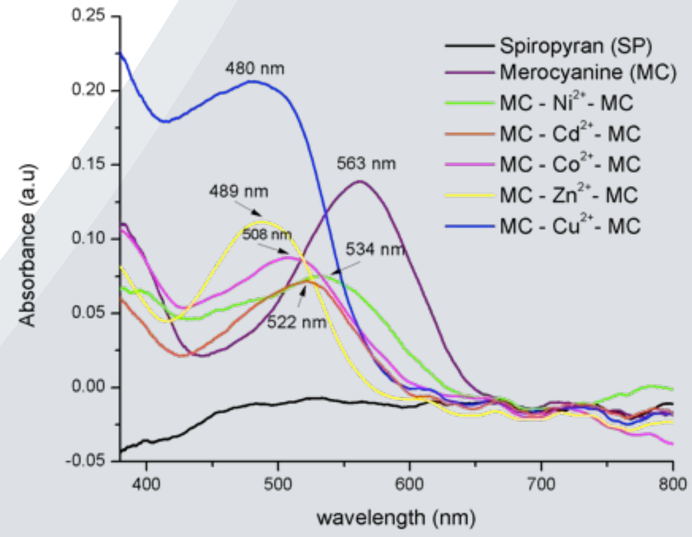




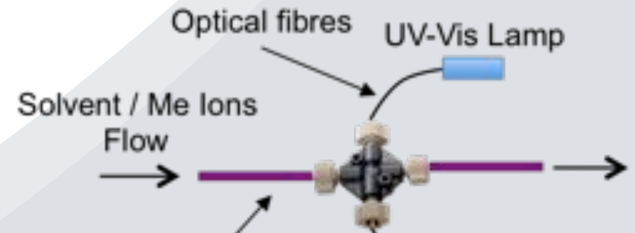
➢ Sensing Properties. 2. Metal Ions Sensing



SP-polymer brushes modified micro-capillaries are capable of detecting different metal solutions that are passing through the modified micro-capillary in continuous flow, based on changes in colour (absorbance spectra) of the coating after irradiation with UV light. Five different metal ions solutions of Co^{2+}, Ni^{2+}, Cu^{2+}, Cd^{2+} and Zn^{2+} were detected.



➢ Applications



- ➢ On-demand solvent sensing
- ➢ On-demand metal ions sensing/binding and releasing in continous flow
- ➢ pH sensing
- ➢ Self-diagnosing tool
- ➢ Photo-control of elecroosmotic flow
- ➢ Integration into commercially available analytical equipment like HPLC and CE

➢ Conclusions

A new, simple and innovative micro-capillary platform capable of solvent and metal ion detection, accumulation and release has been presented. The SP-polymer brushes functionalised micro-capillary constitutes a multi-purpose optical sensor, capable of continuous flow operation.

[1] L. Florea, A. Hennart, D. Diamond, F. Benito-Lopez, *Sens. Act. B*, 2013, *175,* 92-99.

[2] L. Florea, A. McKeon, D. Diamond, F. Benito-Lopez, *Langmuir*, 2013, *29,* 8, 2790-2797

➢ **Acknowledgements :** Irish Research Council - Embark Initiative and Science Foundation Ireland under CLARITY grant 07/CE/I1147.