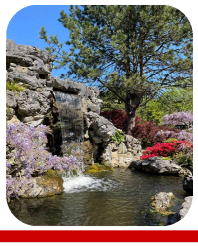
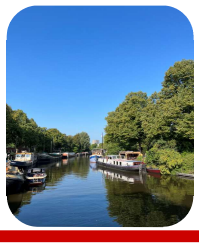
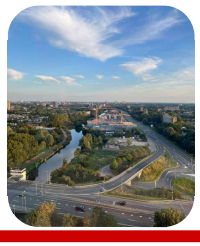
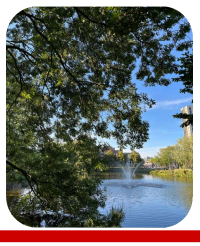
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rijksuniversiteit groningen




THE UNIVERSITY

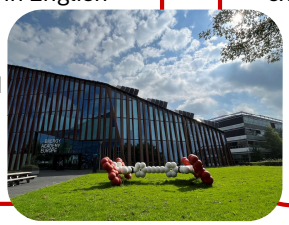
- Founded in 1614, being the second oldest university in the Netherlands.
- Over 36,000 students overall.
- 27% of the student population and 40% of academic staff are international (from 127 countries).
- 11 faculties, 9 graduate schools, 27 research centres and institutes and over 175 degree programmes.
- Majority of courses are in English (over 90 programmes).
- 4 Nobel Prize winners have studied or worked at the university, including Ben Feringa (Chemistry, 2016).

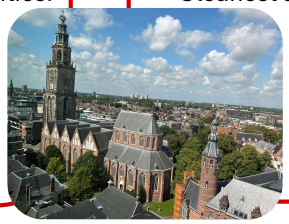
TRAVEL

- German border accessible through the village of Bourtange.
- Stunning nature, with several parks, forests, lakes and nature reserves.
- Good public transport, with many connections but can be expensive.
- Direct train takes 2 hrs 20 mins to Amsterdam Schiphol airport.
- Biking routes make the city easy to explore, with day trip opportunities.

THE CITY

- Over 230,000 inhabitants of over 120 nationalities, of which 25% are students making it one of the youngest cities in the Netherlands.
- Cycling capital of the world, with bikes making up 60% of all traffic.
- Has a well-established art scene.
- Cost of living is like Bath mostly, with some aspects being more expensive.
- Cleanest air out of all Dutch cities.
- Contains the biggest offshore wind park in the world.
- Hundreds of bars, cafes, clubs and restaurants.





MODULES

- All modules are worth 5 credits.
- Two semesters, split into four blocks (1a, 1b, 2a, 2b).

1a

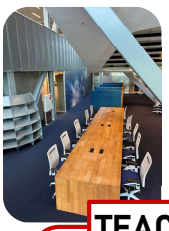
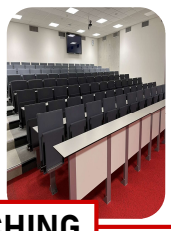
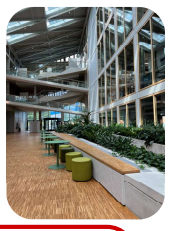
- MSc Structure Determination with Spectroscopic Methods
- BSc Nuclear and Radiochemistry
- BSc Polymer Engineering

1b

- BSc Coordination Chemistry: From Molecules to Materials
- BSc Molecular Biophysics
- MSc Polymer Products

2a & 2b

- Physical and analytical chemistry research project under the supervision of Prof. Wesley Browne as part of the Browne group.

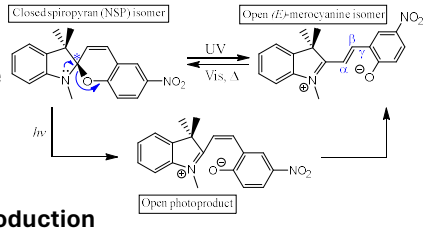




TEACHING

- 2 hr lectures, with a 15 min break.
- Some modules assign homework.
- Tutorials are done with the whole course class rather than groups.

RESEARCH

- Aim: To understand nitrospiropyran (NSP) behaviour in thin films, particularly if the moieties aggregate in polymethyl methacrylate (PMMA) and the effect of protonation on photochromism (reaction scheme seen to the right).



Introduction

- NSP is converted into a coloured zwitterionic or quinoidal merocyanine (MC) isomer through a spiro C-O bond rupture using UV light.
- Systems capable of undergoing this isomerisation can be used as molecular switches in larger applications, including organic electronic devices and optical data storage.
- NSP's photochromic property is retained in polymer thin films, making it an optimal photochrome for multilayer stacking using spin coating.
- Europium and Terbium phosphoresce, allowing for detectability.
- Lanthanide hard Lewis acidic nature suggests potential interactions with MC.

Results and Conclusions

- Formation of a smoother surface when lanthanides were present, indicating that MC was stabilised by the ions that leached into the PMMA layer containing NSP.
- No shifts in bands in the visible region of UV-Vis absorption spectra suggested NSP immobilisation, thus no aggregation unlike in solution.
- Hydroxylethyl cellulose was used to prevent dissolution of the polymer layers. It was found to act as a protective barrier as well as a spacer for the NSP as protonation produced small bands in the visible region which were not expected.
- Lifetime measurements for samples with and without lanthanides highlighted that the lanthanides are likely stabilising zwitterionic MC form through acid-base interactions. Fluorescence observed in the emission spectra of multilayers containing lanthanides and NSP was likely to be the result of protonated MC, as isolated by TCSPC.

Future Work

- Use of quartz slides for improved accuracy as glass slides scatter light intensely, causing difficulties in lifetime value determination.
- Effect of multiple switching of NSP in the thin film.