SYNERGY OF DIFFERENT FLUORESCENT ENHANCEMENT EFFECTS ON SPIROPYRAN APPENDED ONTO CELLULOSE

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PRESENTATION OVERVIEW

Introduction

Experimental Details

Results

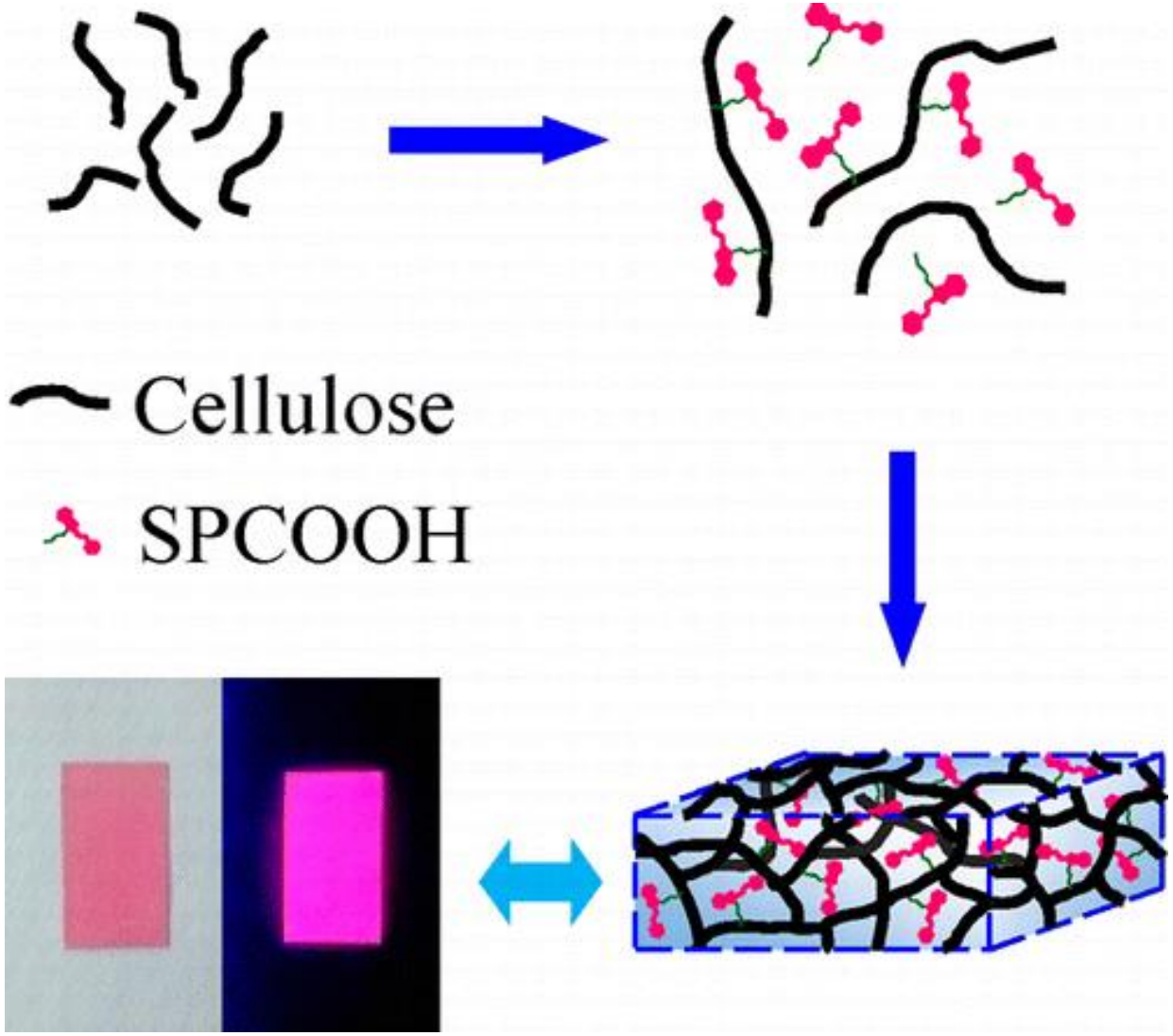
Conclusions and Possible Applications

INTRODUCTION

Tian and Tian developed spiropyran paper which increased spiropyran's fluorescence signal by an order of magnitude by combining

- Highly polar environment within the porous cellulose
- Conformational constraints within cavities
- Elimination of solvent influence

Claim that the increase in fluorescence rivals quantum dots.



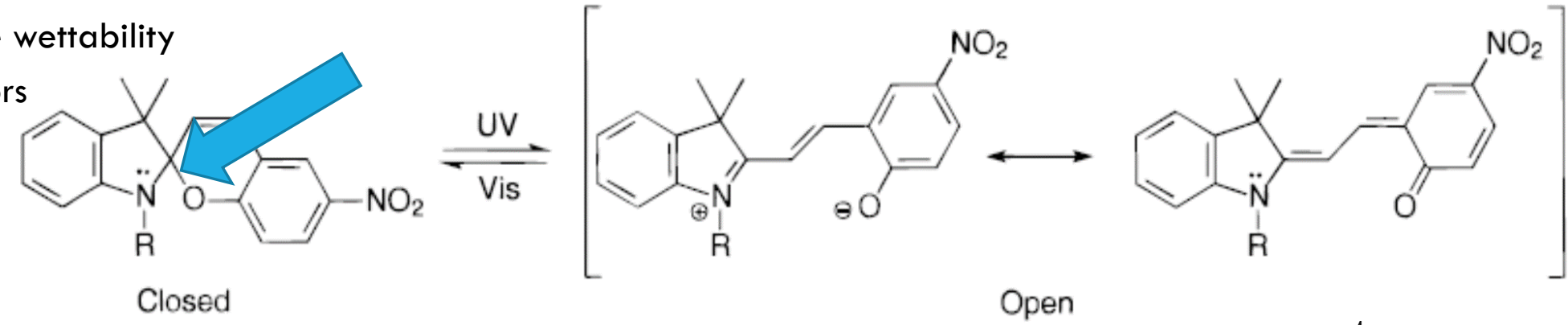
INTRODUCTION

Spiropyrans have been heavily investigated since the 1950's

Currently utilized in:

- Bioimaging
- Chemical Sensors
- Controlled Release
- Data Storage
- Photocontrollable wettability
- Mechanical sensors

Authors claim there is a lack of study on spiropyran's fluorescence and research on amplifying the fluorescence signal.



EXPERIMENTAL DETAILS: SYNTHESIS OF 3-(3',3'-DIMETHYL-6-NITROSPIRO[CHROMENE-2,2'-INDOLIN]-1'-YL)PROPRANOIC ACID (SPOOCH)

8.50g 1-(2-carboxyethyl)-2,3,3-trimethyl-3H-indolium bromide & 2.32g piperidine were dissolved in 20 mL of distilled 2-butanone and then stirred for 10 min.

4.51g 2-hydroxy-5-nitrobenzaldehyde was added, the mixture was refluxed for 3h in a nitrogen atmosphere

.The solution was cooled overnight at ambient temperature.

The precipitate was obtained by filtration and further purified by a silica gel column

The product was a green-yellow powdera nd characterized by FTIR and H^1 NMR

Chen, J.; Zeng, F.; Wu, S.; Chen, Q.; Tong, Z. A core–shell nanoparticle approach to photoreversible fluorescence modulation of a hydrophobic dye in aqueous media Chem.—Eur. J. 2008, 14 (16) 4851–4860

EXPERIMENTAL DETAILS: SYNTHESIS OF SP-CELLULOSE

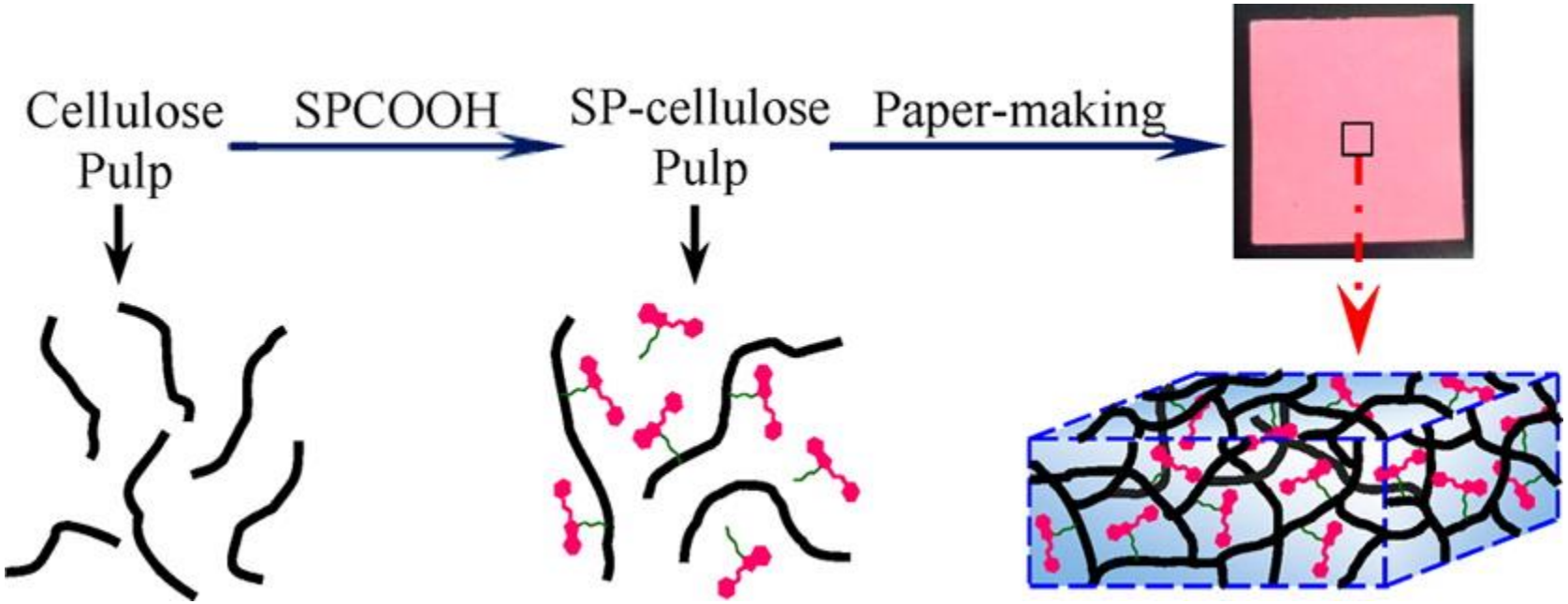
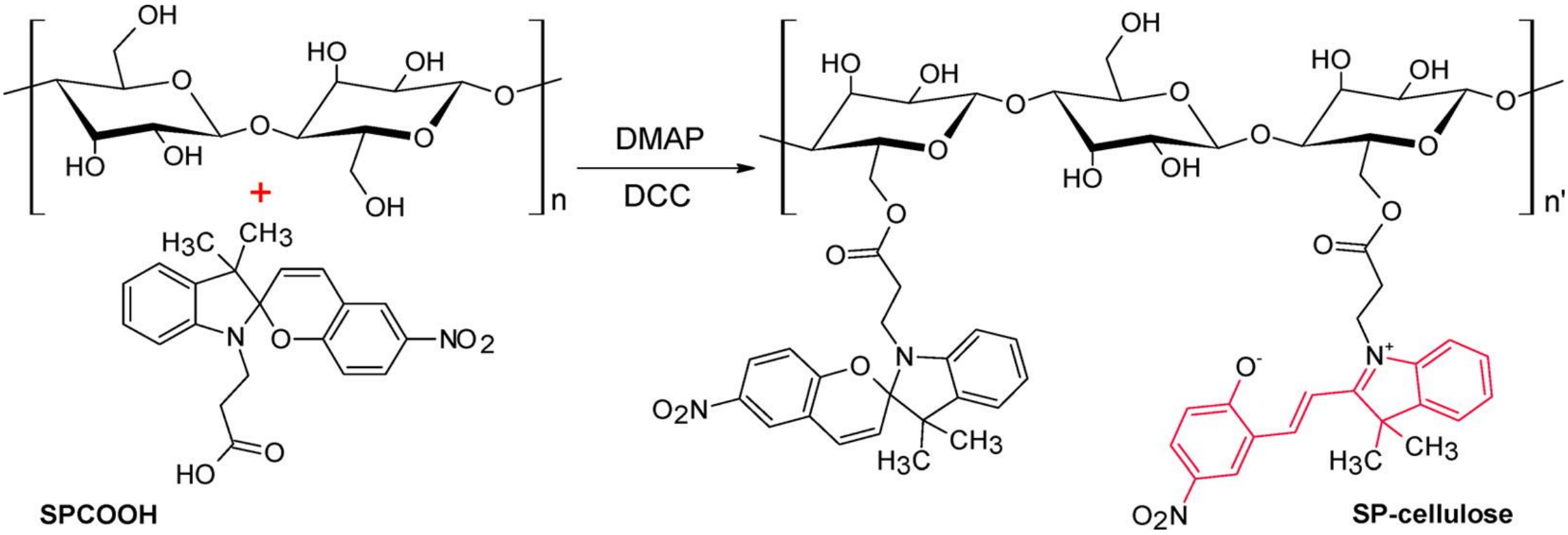


Figure 1. Schematic procedure to prepare the SP–cellulose paper sample.

EXPERIMENTAL DETAILS: SYNTHESIS OF SP-CELLULOSE



Scheme 1. Synthesis of SP–Cellulose

EXPERIMENTAL DETAILS: SYNTHESIS OF SP-CELLULOSE

Preparation of cellulose pulp

- Blended high quality filter paper in tetrahydrofuran

Synthesis of SP-Cellulose Pulp

- A solution of SPOOCH, DMAP and THF was added to the pulp mixture and cooled to 0°C
- A solution of DCC and THF was added to the mixture dropwise and stirred below 0°C for 2hrs, then removed from ice and stirred at room temperature for 24hr
- Product is filtered and washed with THF, EtOH and H_20
- Product is distributed in 500mL DI. H_20 and blended

Preparation of SP-Cellulose Paper

- Paper prepared via the conventional method

EXPERIMENTAL DETAILS: FTIR CHARACTERIZATION

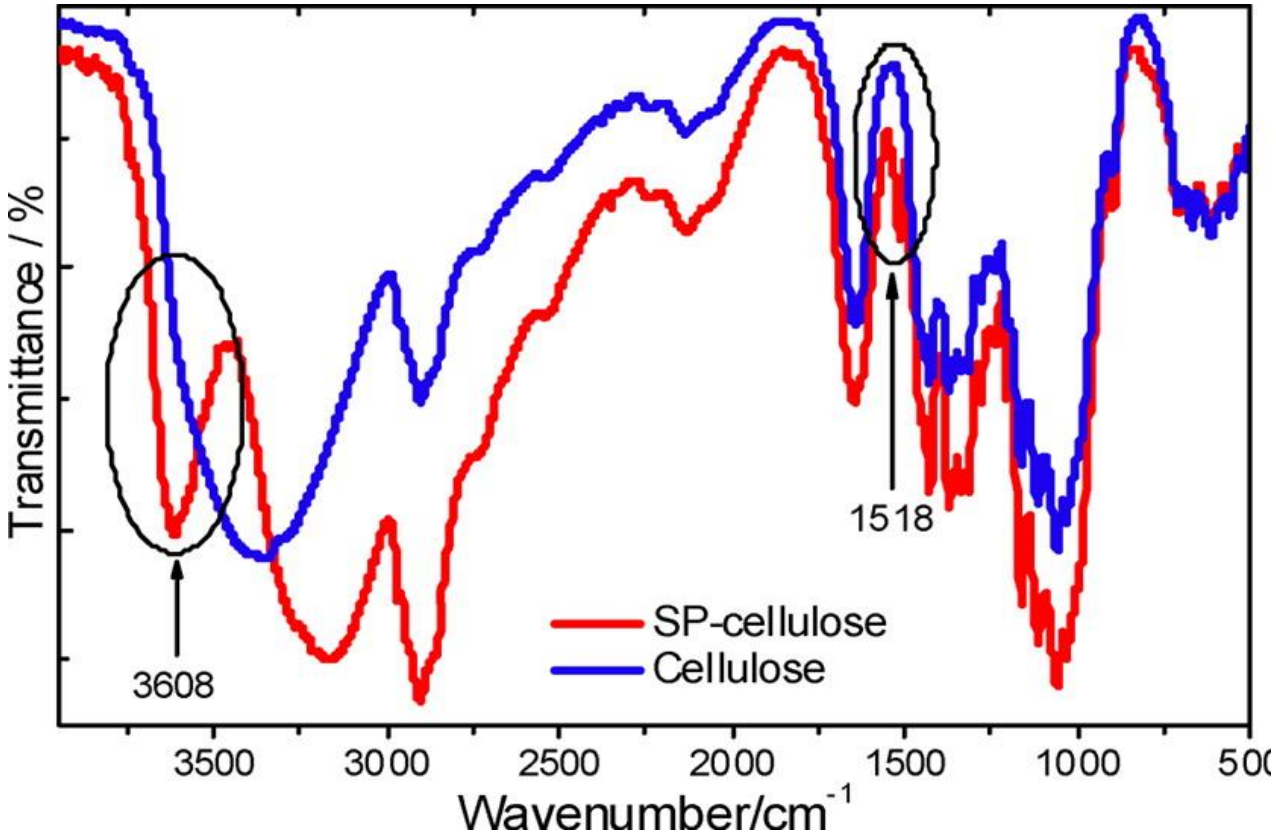


Figure 2. FTIR spectra of cellulose and the cellulose grafted with SP.

RESULTS & DISCUSSION: MECHANISM OF QUENCHING

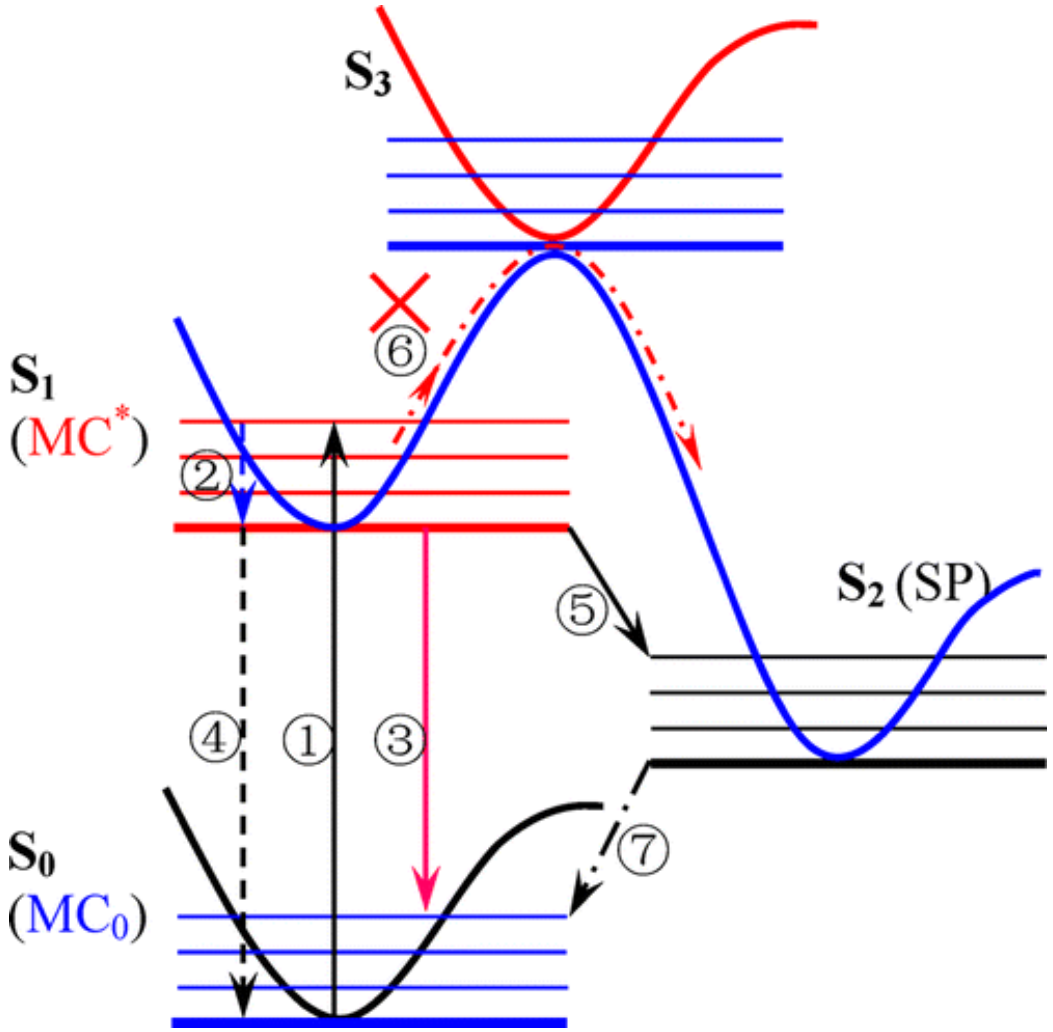


Figure 3. Modified Jablonski diagrams

RESULTS & DISCUSSION: FLUORESCENT ENHANCEMENT IN SP-CELLULOSE

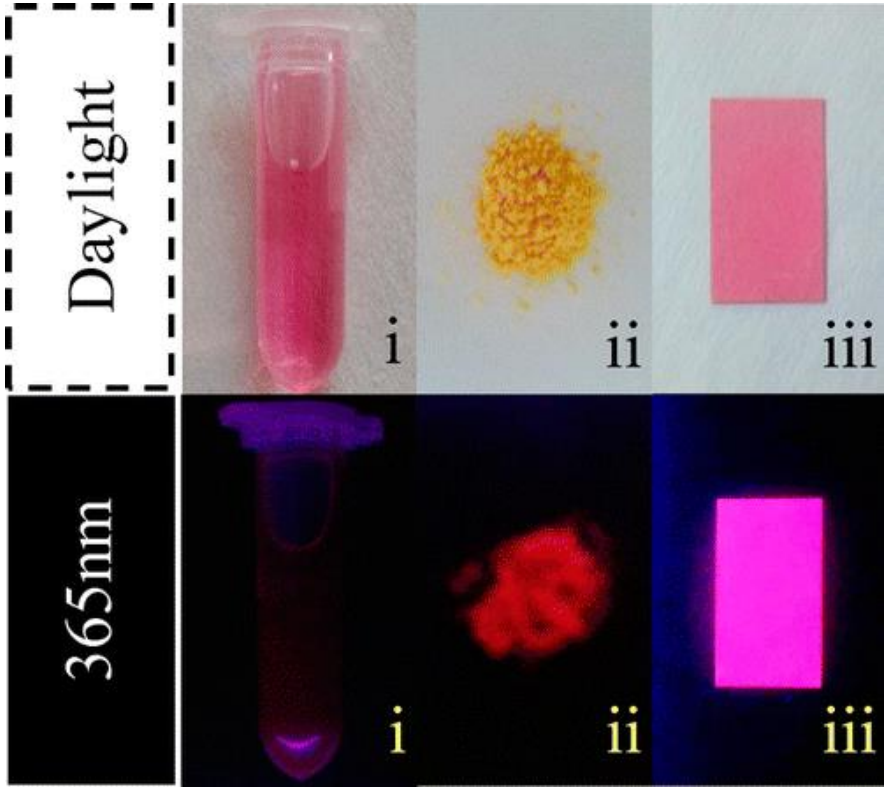


Figure 4. Photographs of spiropyran in different states under the (up) visible light and (down) ultraviolet (UV) irradiation of 365 nm at 25 °C

RESULTS & DISCUSSION: FLUORESCENT ENHANCEMENT IN SP-CELLULOSE

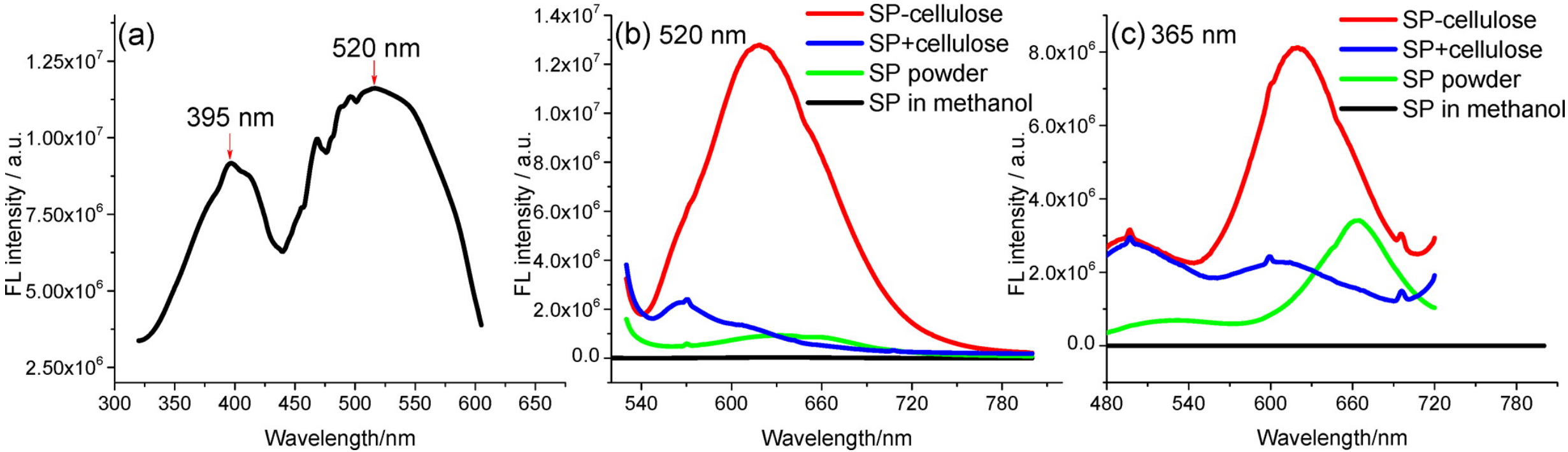


Figure 5. Fluorescence spectra of spiropyran at 25 °C in different conditions: (a) excitation spectrum at 620 nm, (b) emission spectra excited at 520 nm, (c) emission spectra excited at 365 nm.

RESULTS & DISCUSSION: FLUORESCENT ENHANCEMENT IN SP-CELLULOSE

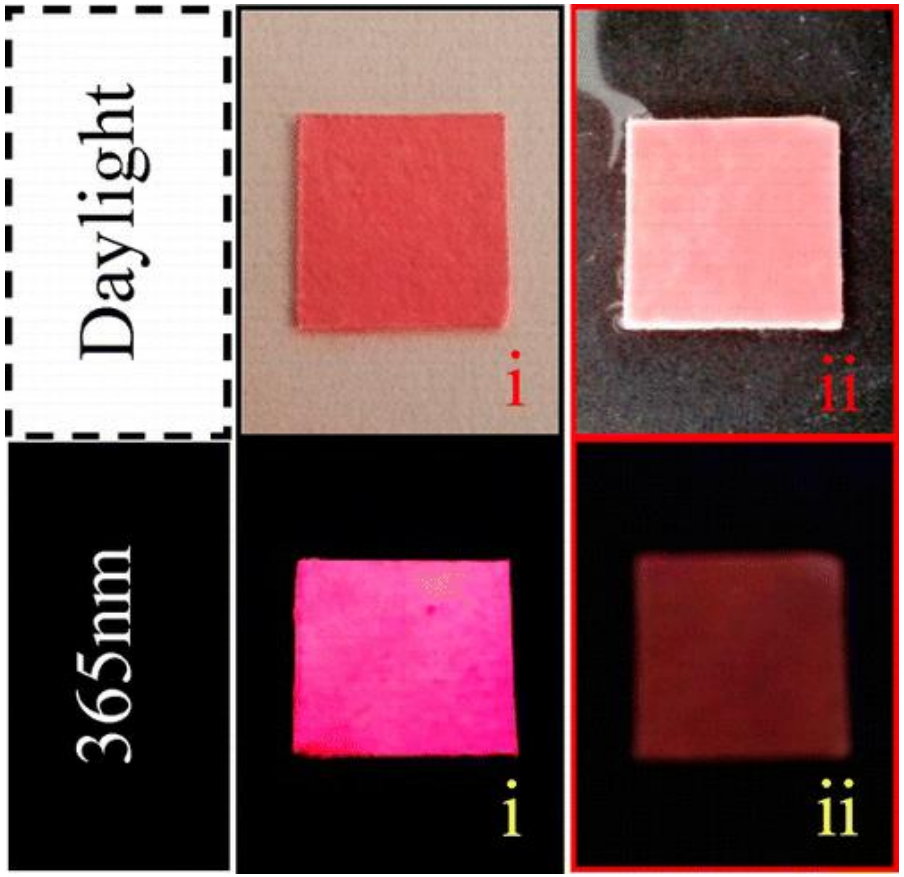


Figure 6. Photographs of SP–cellulose paper (1.5 × 1.5 cm) under the (up) visible light and (down) UV irradiation of 365 nm at 25 °C (i) before and (ii) after soaking in hexane for 2 min.

RESULTS & DISCUSSION: DURABILITY OF SP-CELLULOSE

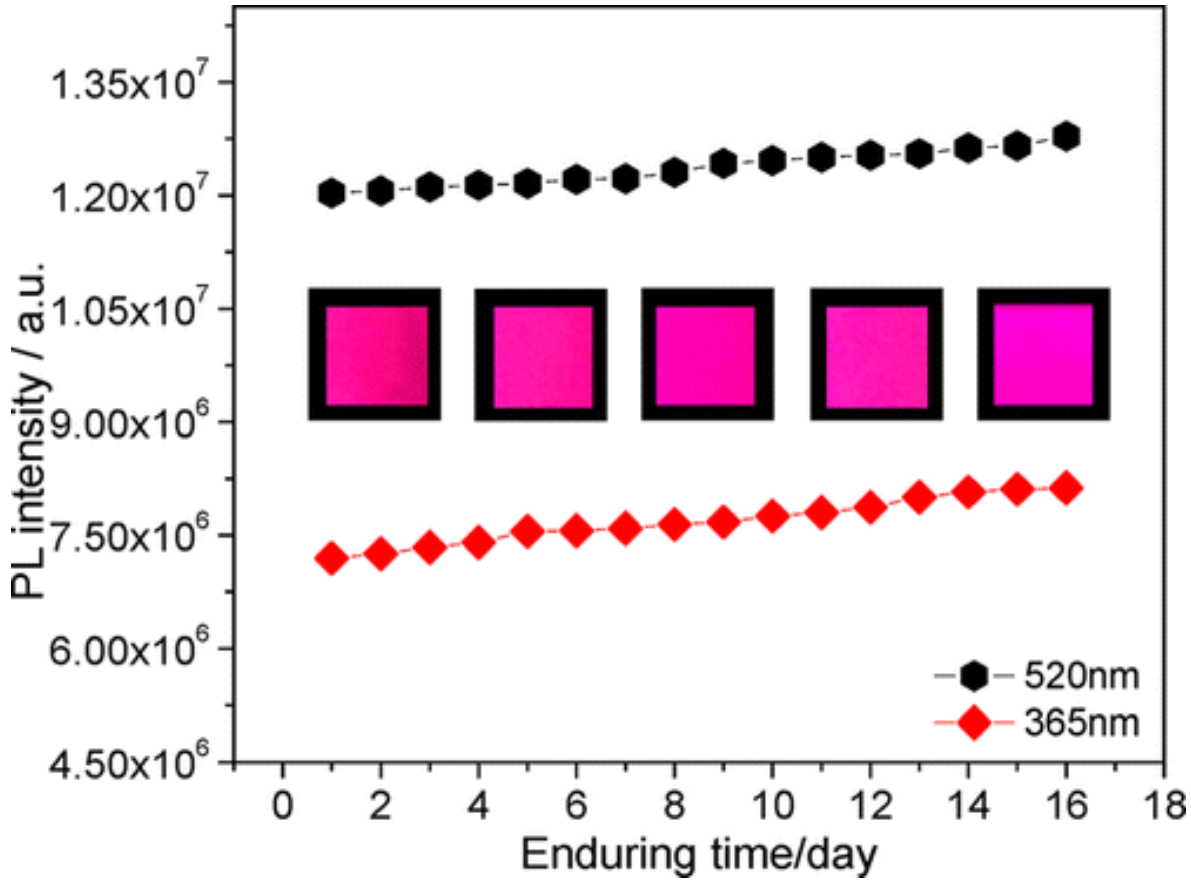


Figure 7. Flourescence intensity variations of SP-Cellulose paper samples stored in darkness at 25°C for over time.

CONCLUSION

Presentation of a method to fabricate a SP-cellulose material

Fluorescence of spiropyran can be enhanced by appending spiropyran into a cellulose matrix

- Polar interior environment
- Conformational constraints
- Elimination of solvent influences

Possible applications

- Organic photoswitchable QDs
- Integration into a test paper
  - Environmental testing/monitoring

THANK YOU

Photon-Controlled Phase Partitioning of Spiropyrans Antonio A. García,*,†, Suman Cherian,‡, Jin Park,§, Devens Gust,*,§, Frank Jahnke,*,∥ and, and Rohit Rosario† The Journal of Physical Chemistry A 2000 104 (26), 6103-6107