

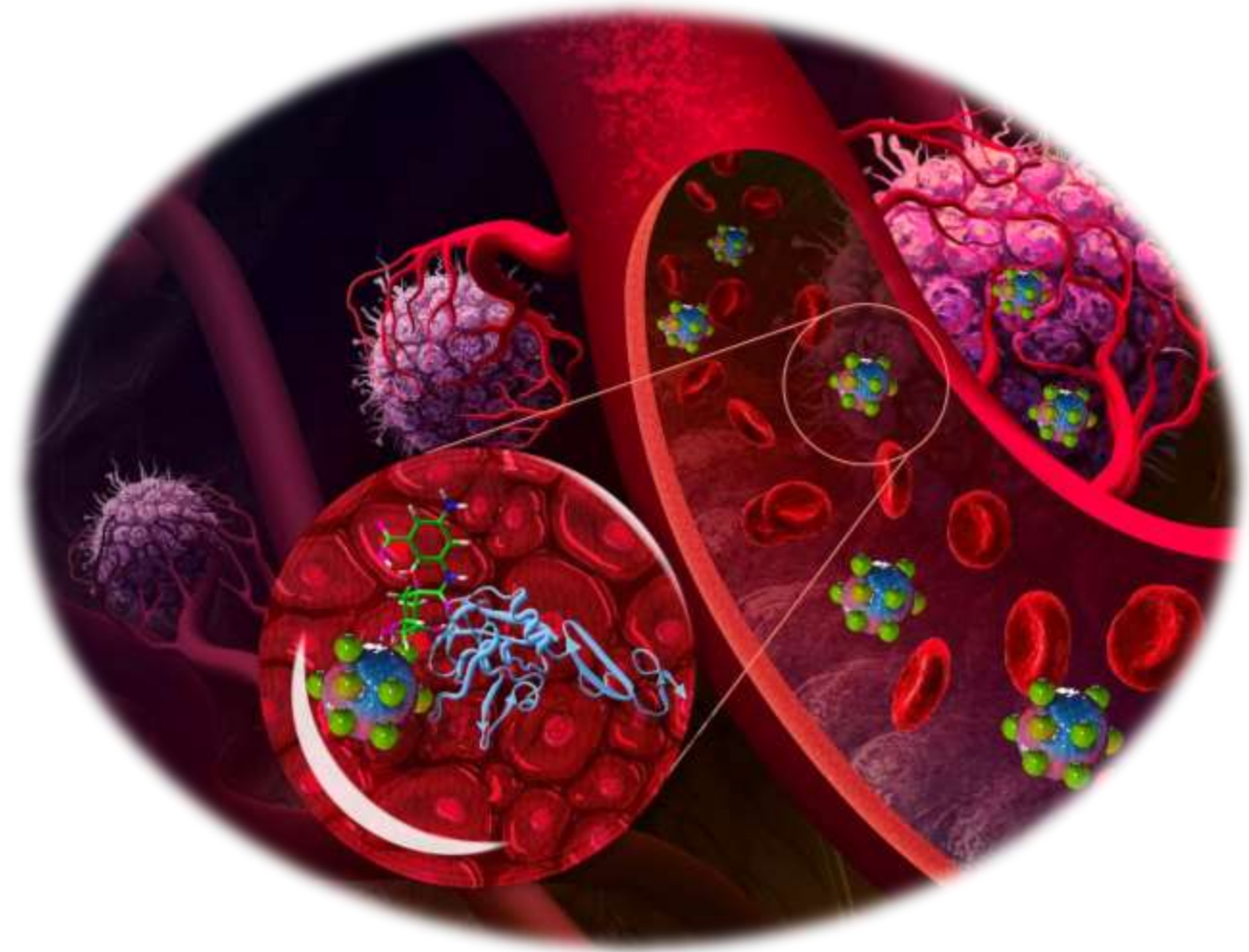
# Fluorophore-Labelled Nanoparticles for Monitoring of pH-Responsive Structural Change and Drug Release

Yanting Gao

Supervisors: A/Prof Georgina Such  
Dr. Chris Ritchie

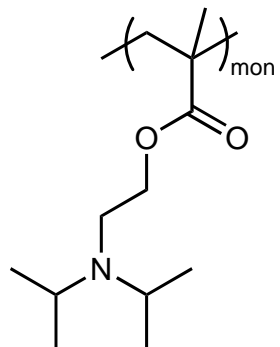
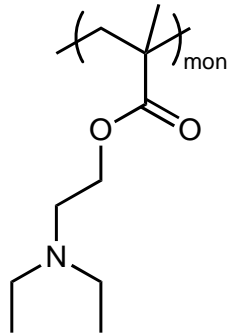


- **Higher stability and lower toxicity**
- **Designed with specific properties**  
size, shape, surface charge
- **Stimuli responsiveness**  
pH, redox, enzyme, temperature, light



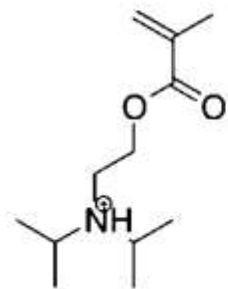
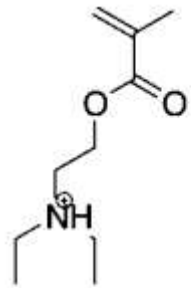
# pH-Responsive Materials

## PDEAEMA



## PDPAEMA

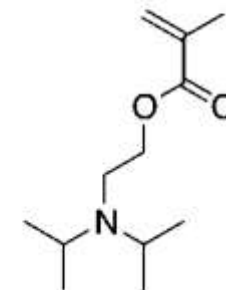
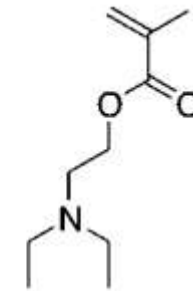
$pK_a \sim 7$



$pK_a \sim 6$

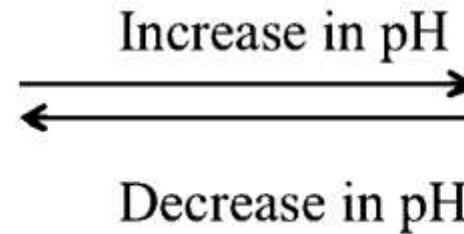
## DEAEMA

2,2-(diethylamino) ethyl methacrylate



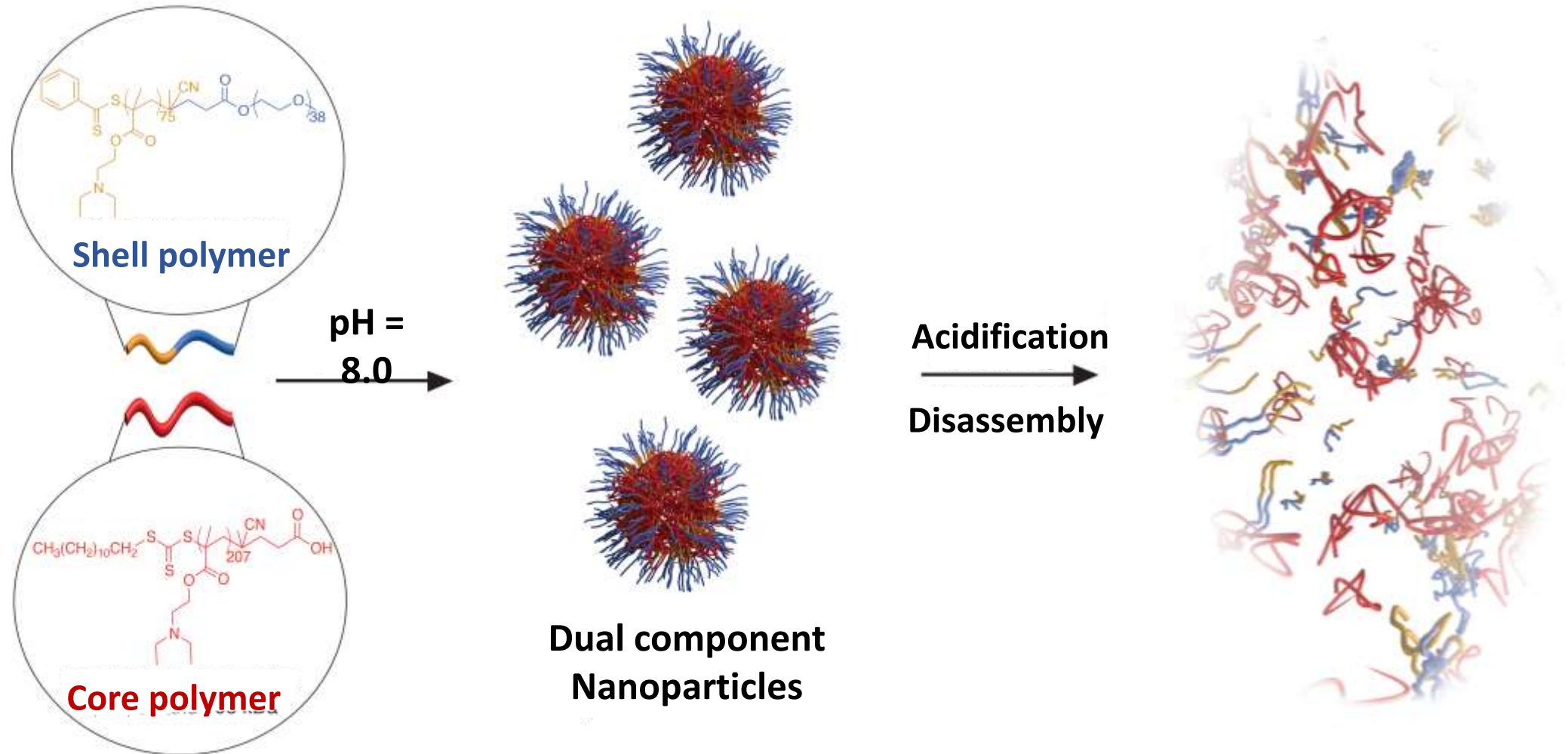
## DPAEMA

2,2-(diisopropylamino) ethyl  
methacrylate



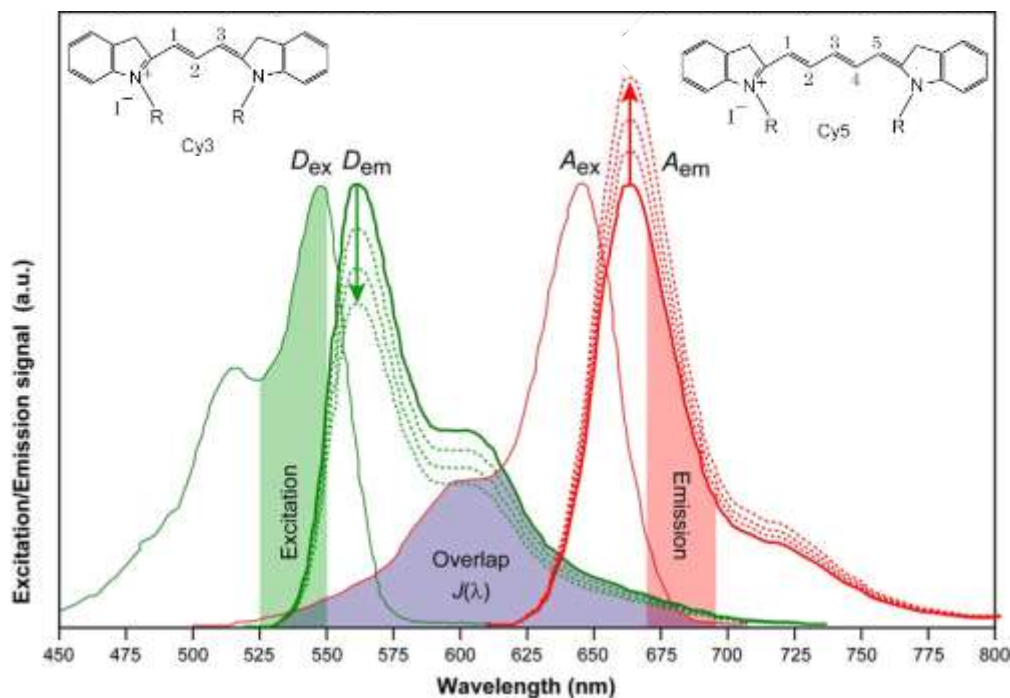
# Core-Shell Nanoparticles Self-Assembly

## Nanoprecipitation



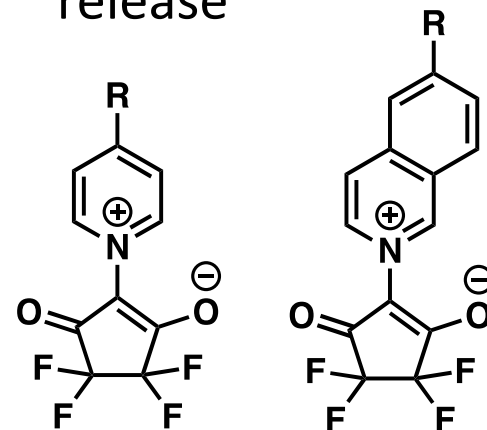
## Non-switchable Fluorophores

- the cyanine dye family
- good biocompatibility and photostability



## Switchable Fluorophores

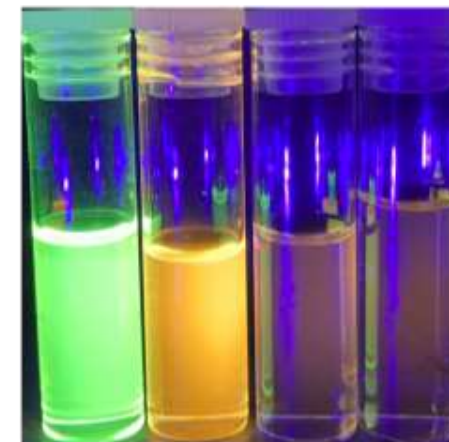
- signal turns on/off in response to stimuli
- indicating local environment change/carriers' structural change/drug release



Pyridinium  
Betaines

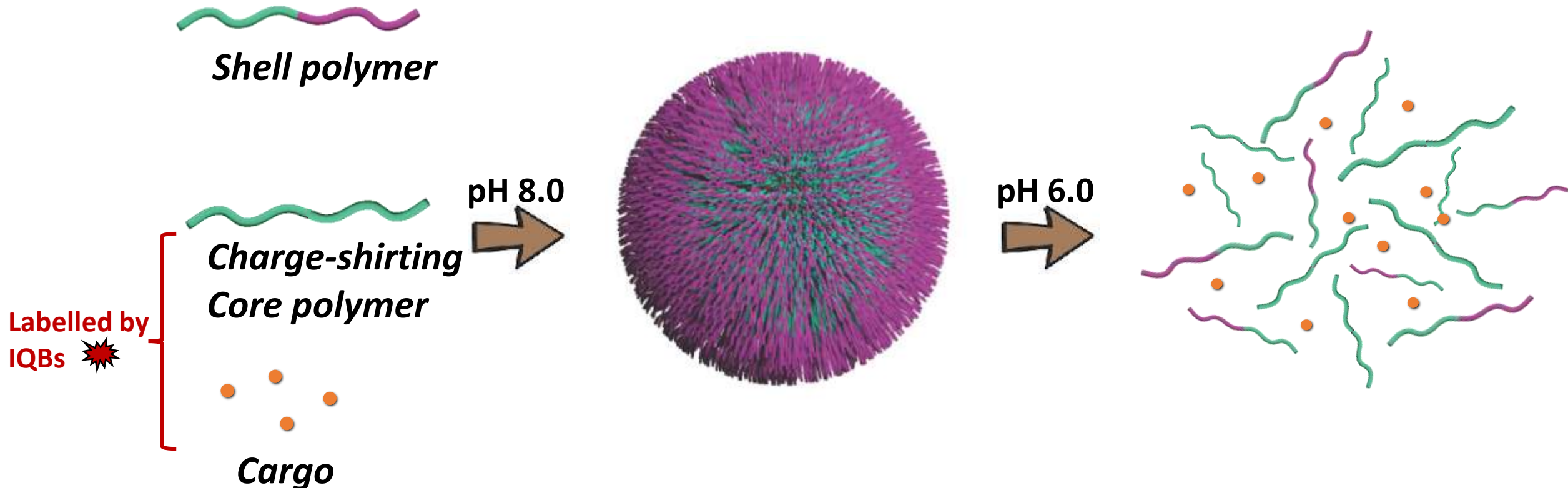
Isoquinoline  
Betaines  
(IQBs)

Toluene DCM ACN MeOH



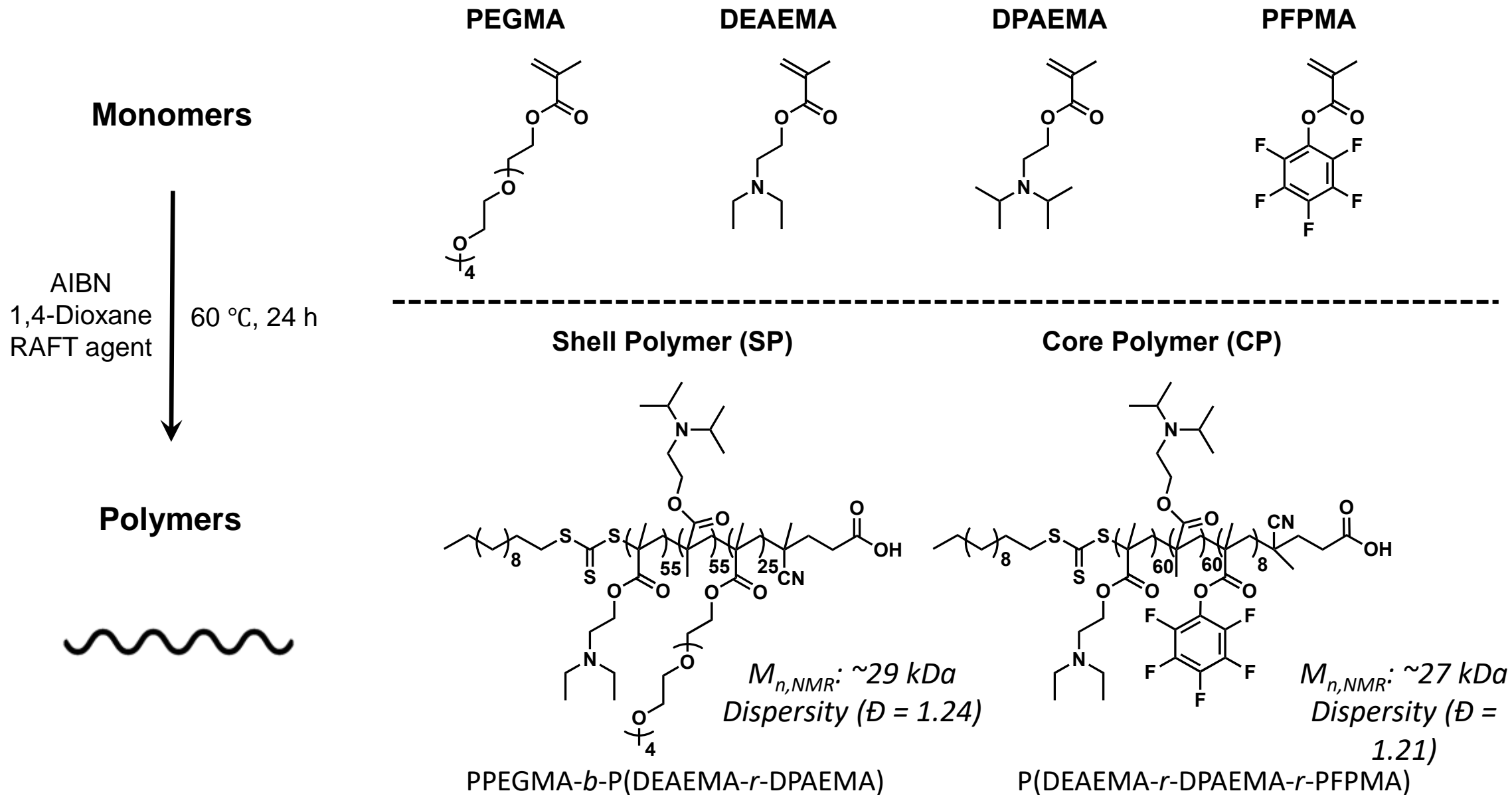
solvatochromic properties

# Project Overview

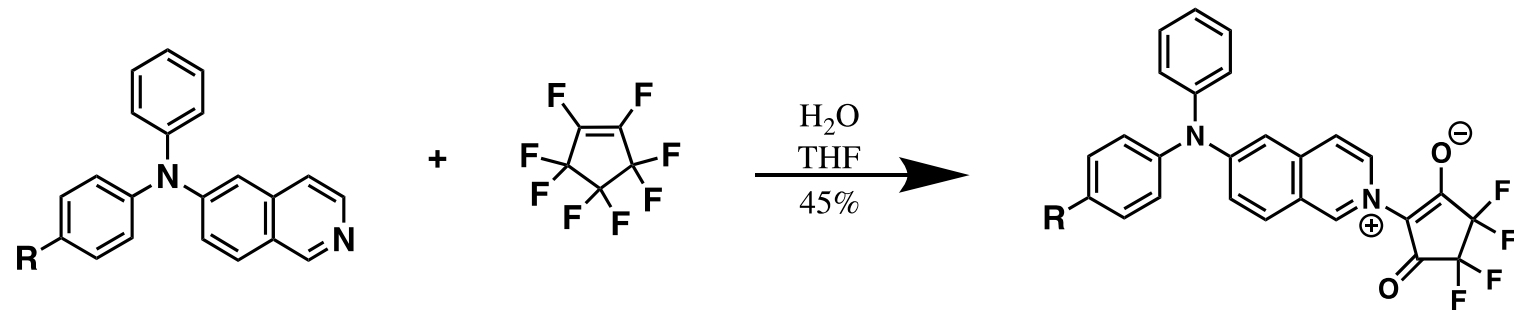


- Monitoring of internal hydrophilic transition
- Monitoring of drug loading and release

# Synthesis of Polymers and IQBs

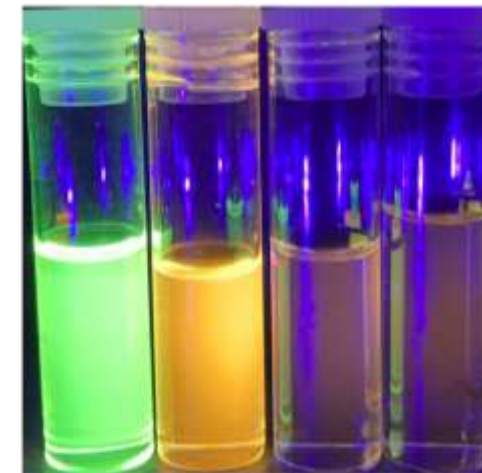


# Synthesis of Polymers and IQBs

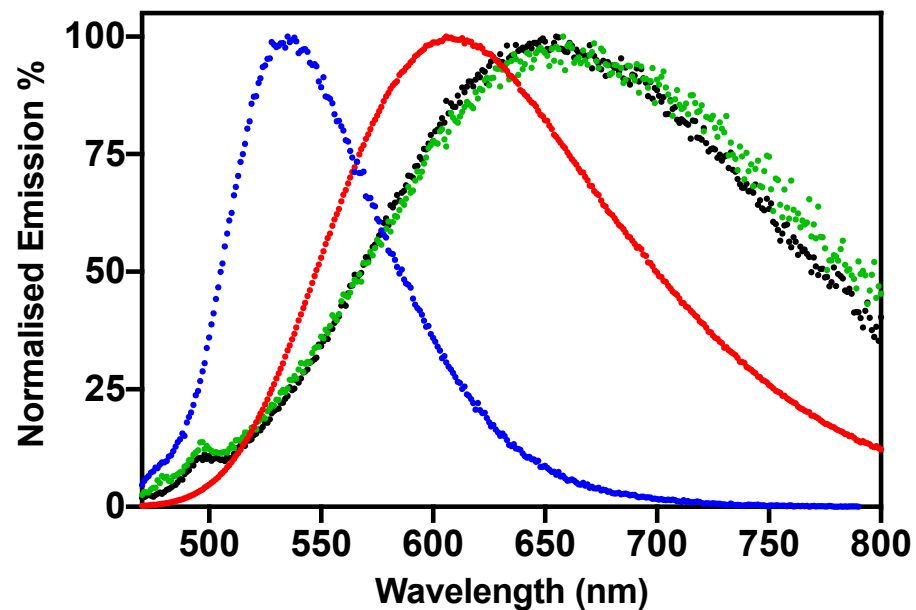
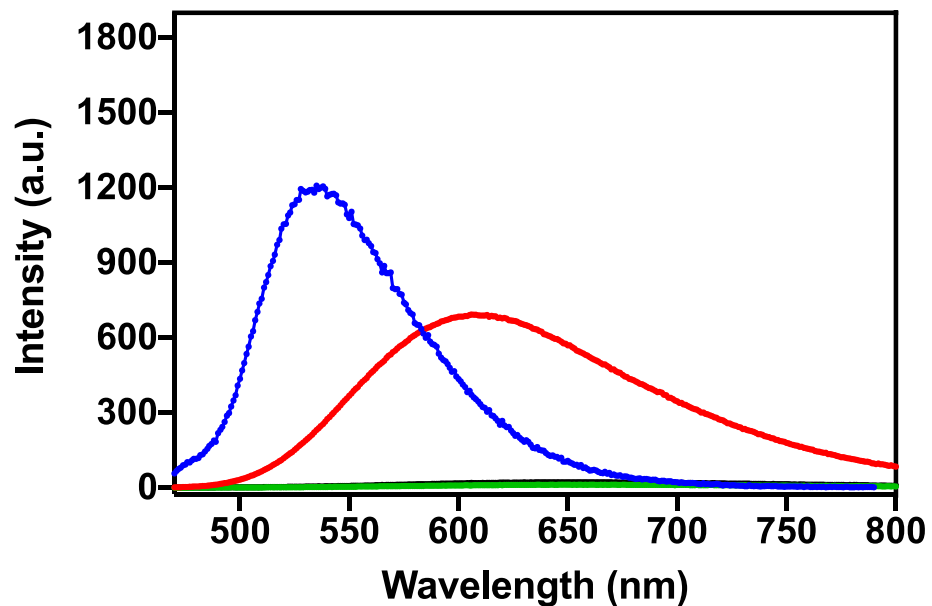


Isoquinoline precursor Octafluorocyclopentene

Isoquinoline Betaines (IQBs)



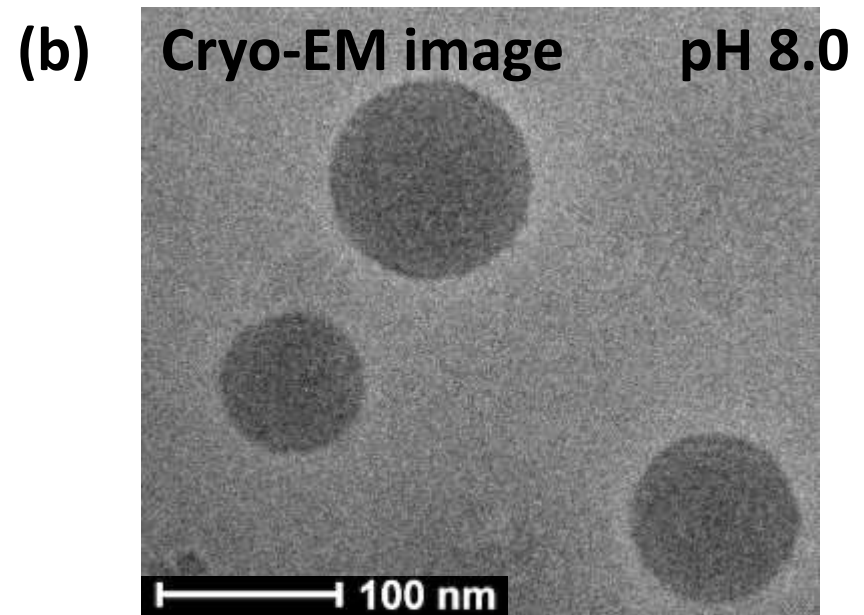
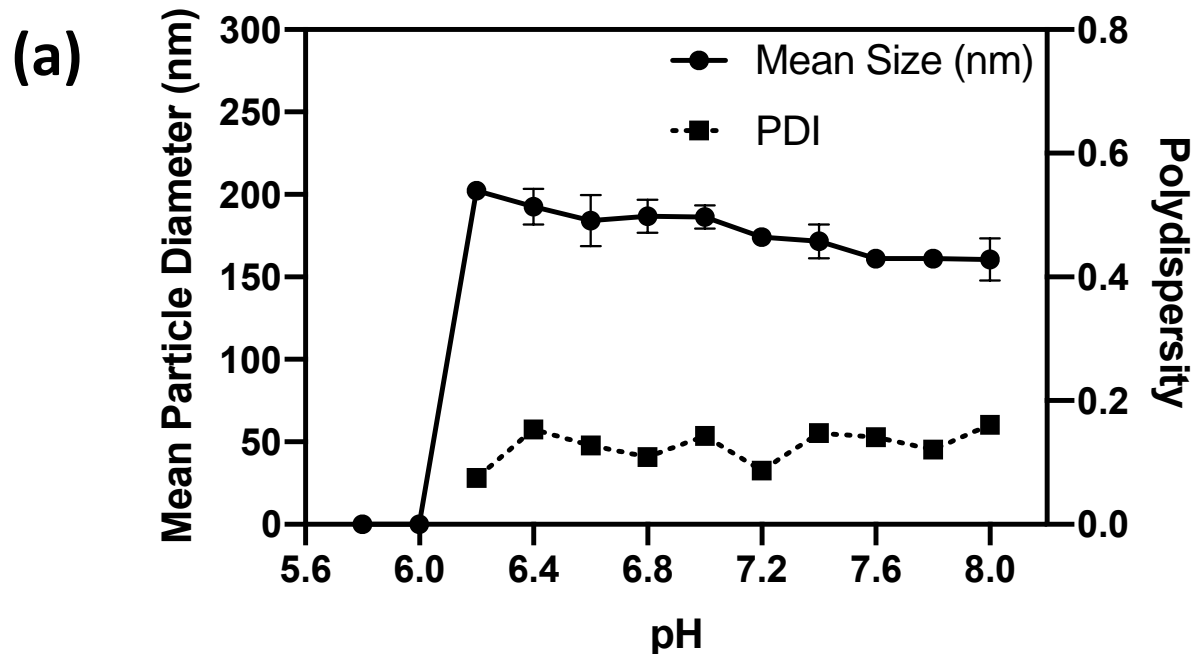
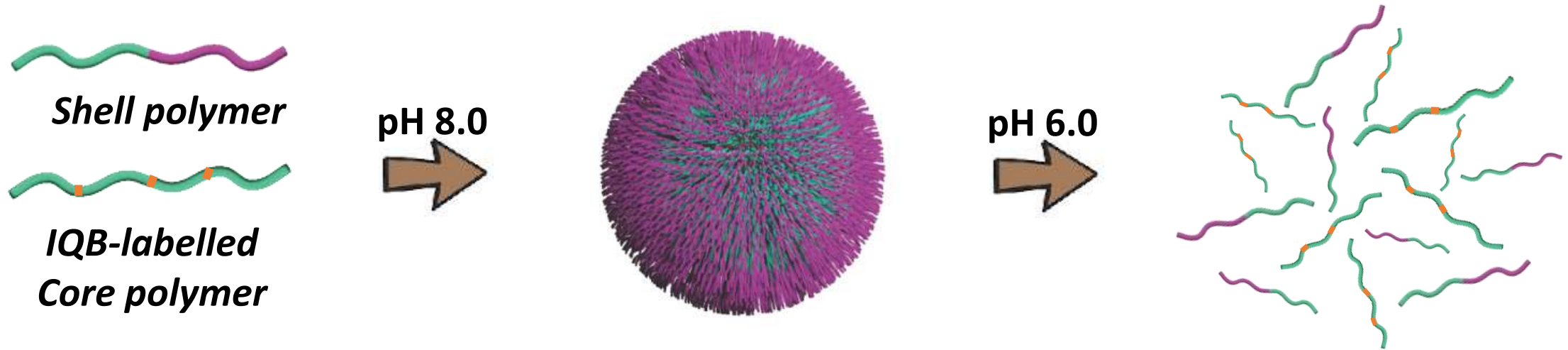
\* Ex Wavelength 430 nm



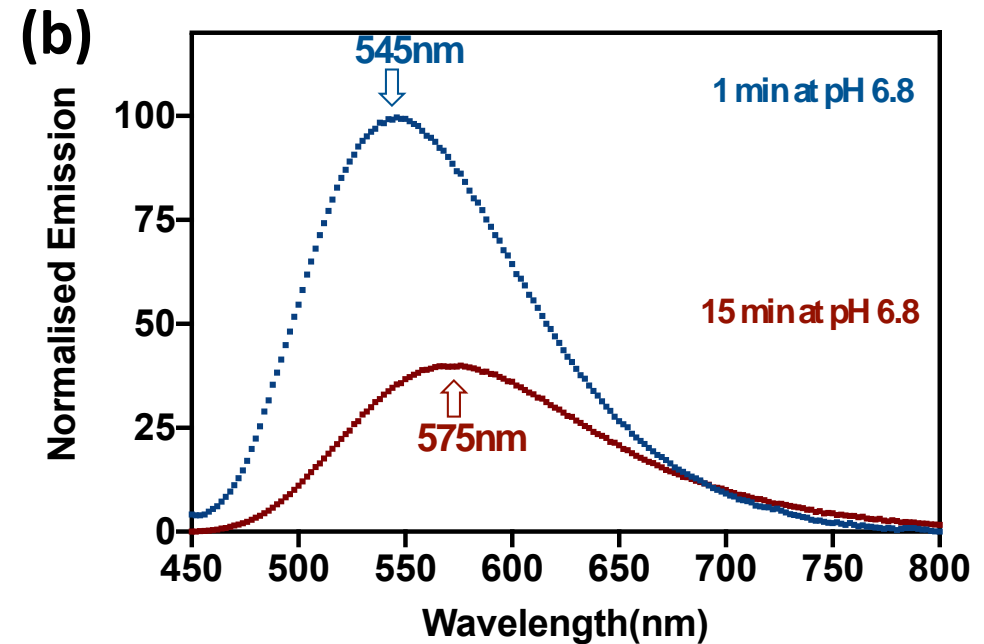
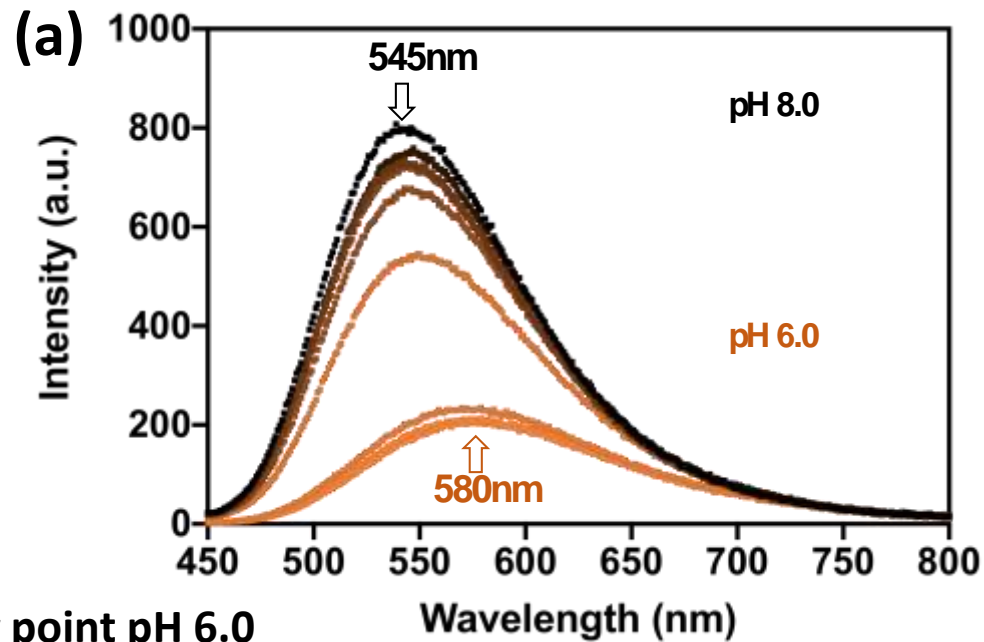
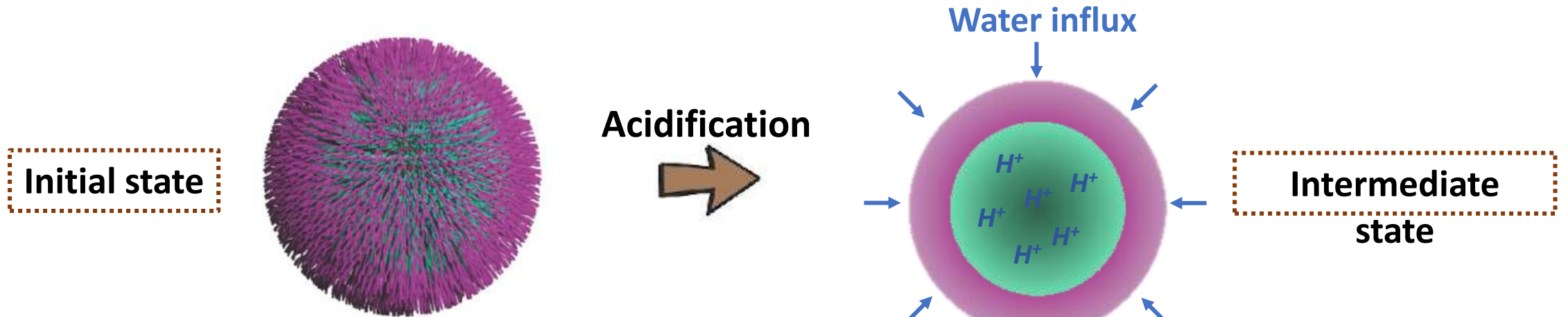
Solvent	PLQY
Toluene	0.56
Dichloroethane	0.16
Acetonitrile	0.004
Acetone	0.003



# Monitoring of Internal Hydrophilic Transition



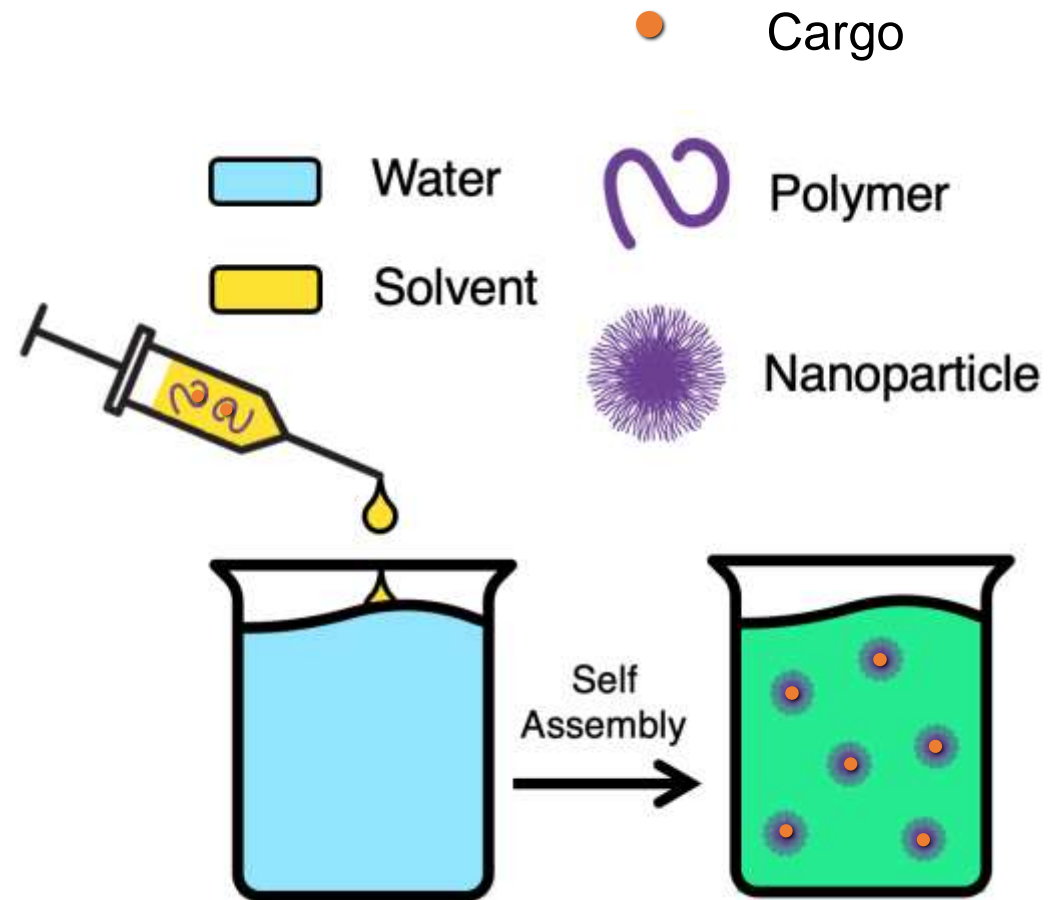
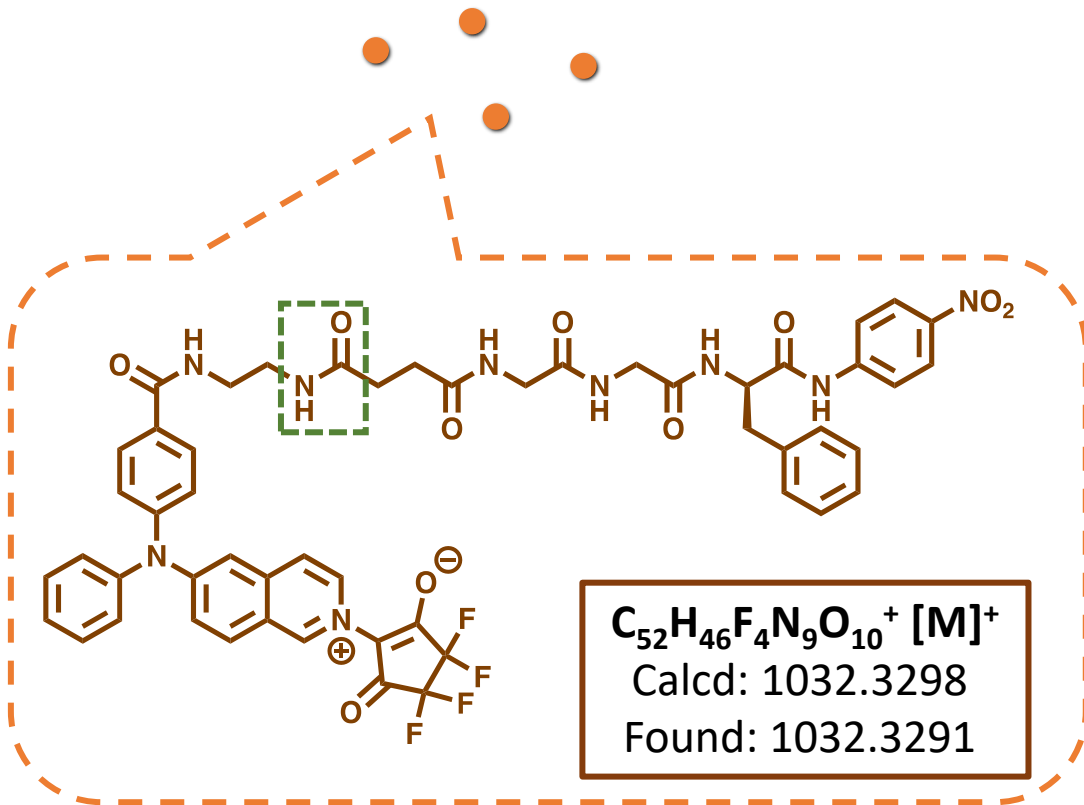
# Monitoring of Internal Hydrophilic Transition



\* Disassembly point pH 6.0

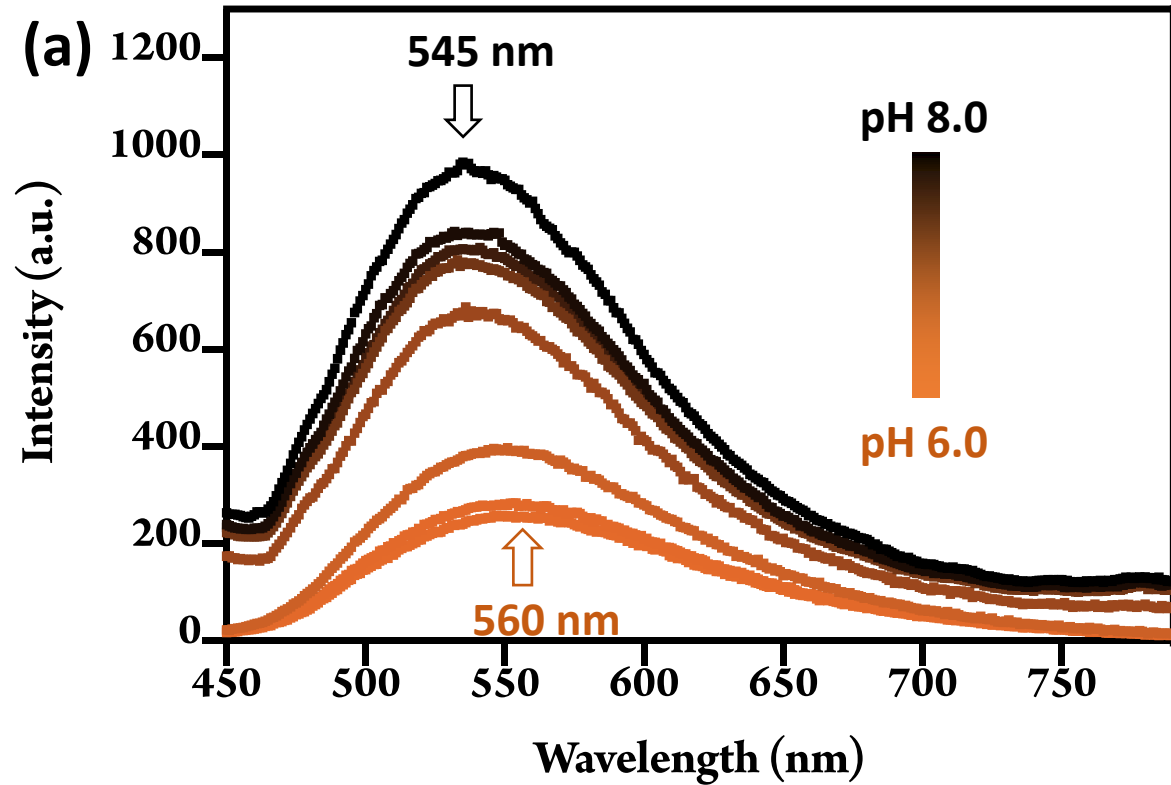
\* Ex Wavelength 430 nm

## IQB-Peptide Cargos

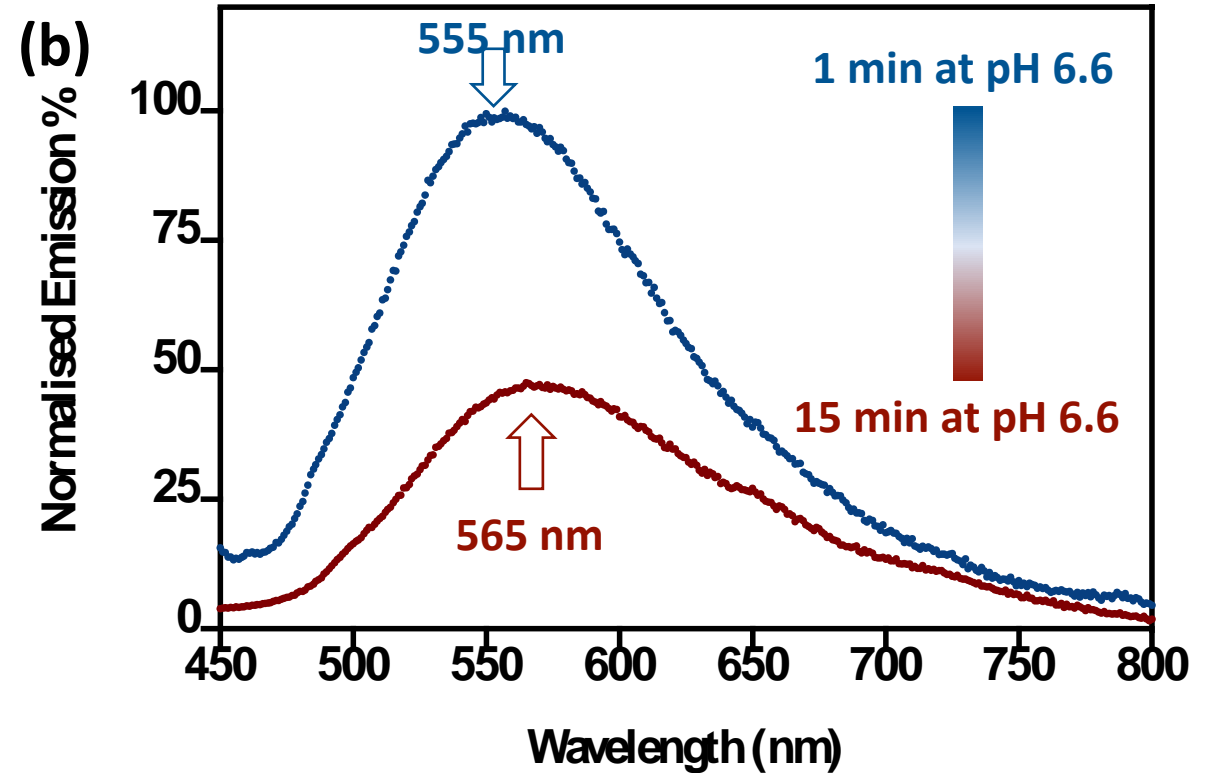


# Monitoring of Drug Loading and Release

\* Ex Wavelength 430 nm

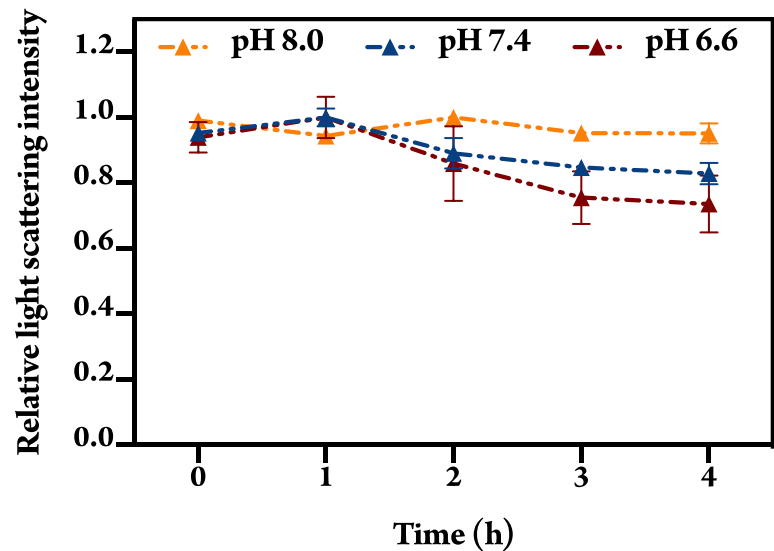
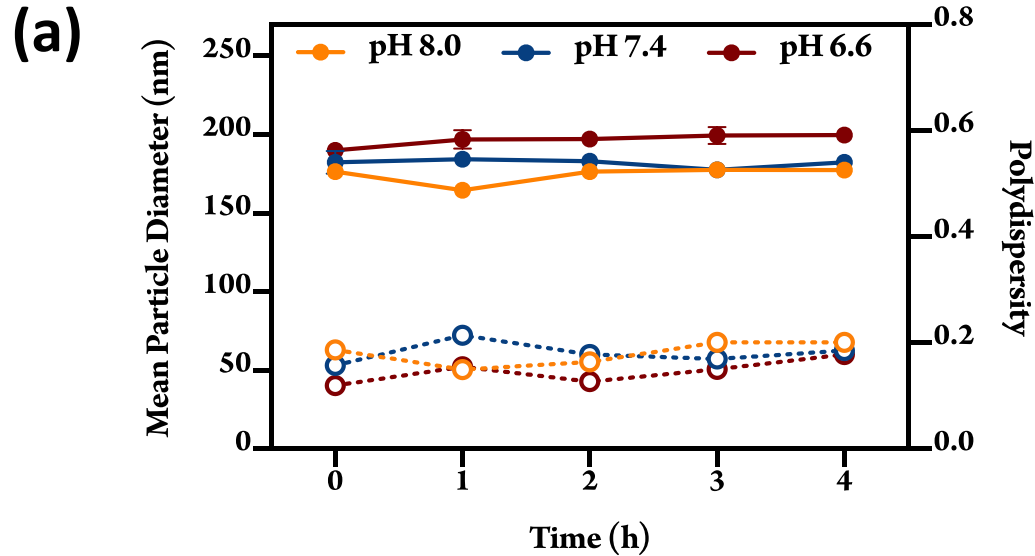


Successfully encapsulated  
cargos in hydrophobic region



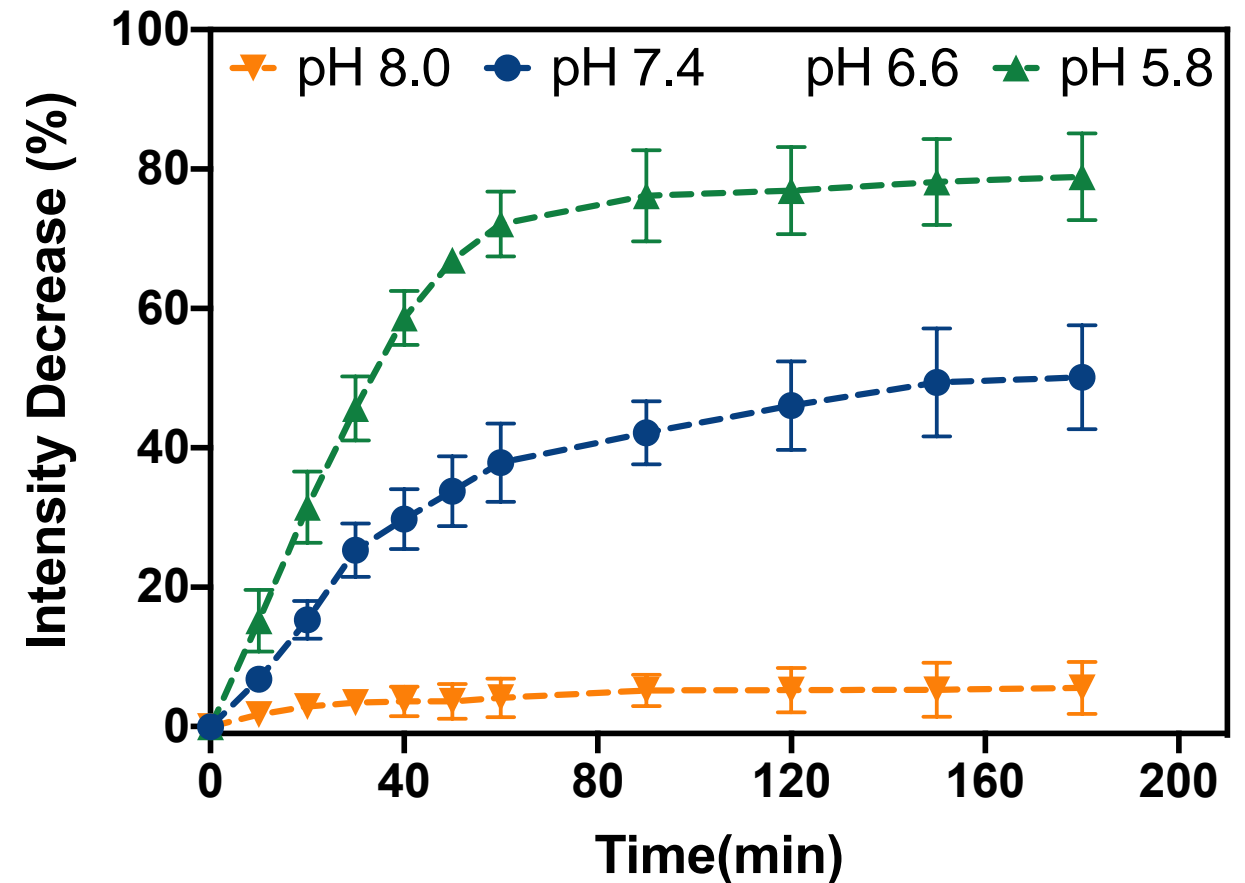
Internal hydrophilic transition

## Nanoparticle stability tests

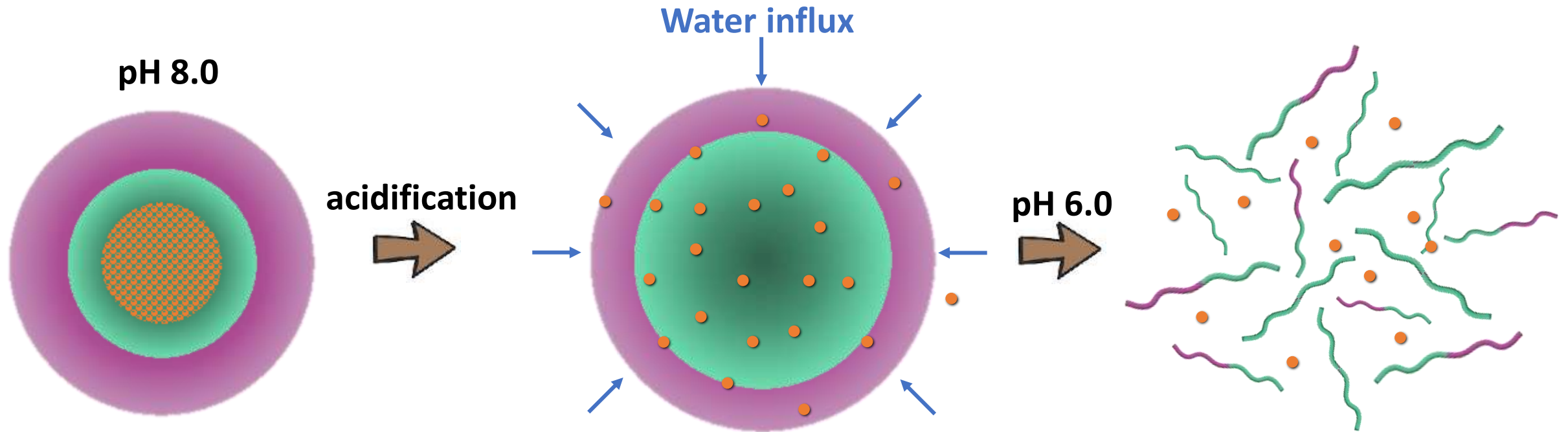


(b)

## Drug release profile



# Conclusions



- pH-responsive nanoparticles will completely disassemble in response to acidification
- Emission spectra offered insights into cargo distribution and change of internal environment
- Drug release behaviors monitored by absorption spectra

# Acknowledgements



## TrACEES Platform

Trace Analysis for  
Chemical, Earth and  
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MONASH University



## Supervisors:

- ❖ A/Prof Georgina Such
- ❖ Dr. Chris Ritchie

## Postdoc

- ❖ Dr. Changhe Zhang
- ❖ Dr. Sarah Kermaniyan
- ❖ Dr. Umeka Nayanathara
- ❖ Dr. Samuel Smith

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**Thank you for your  
attention!**

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