

# Solubilization Capacity of a Crosslinked Micellar Gel

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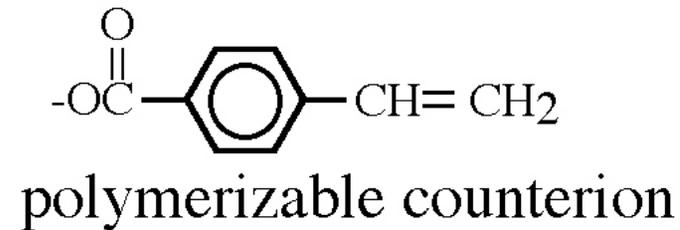


# Outline

- Polymerizable surfactant
- Crosslinking of micelles -> “macro-micelle”
- Characterization using SANS and optical microscopy
- USANS confirmation of solubilization kinetics

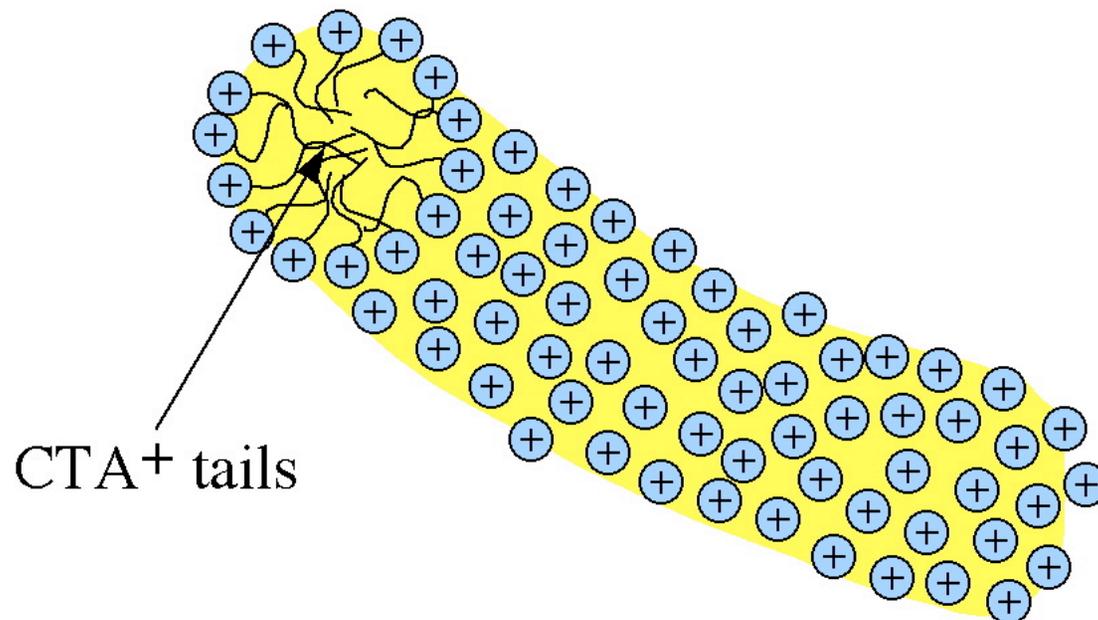
# Polymerizable Surfactant

CTVB: Cetyltrimethylammonium 4-vinyl benzoate



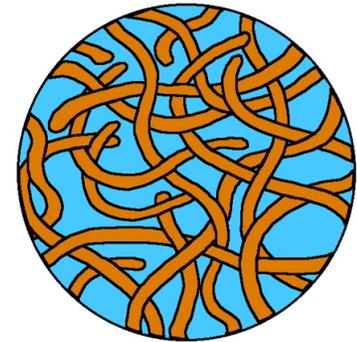
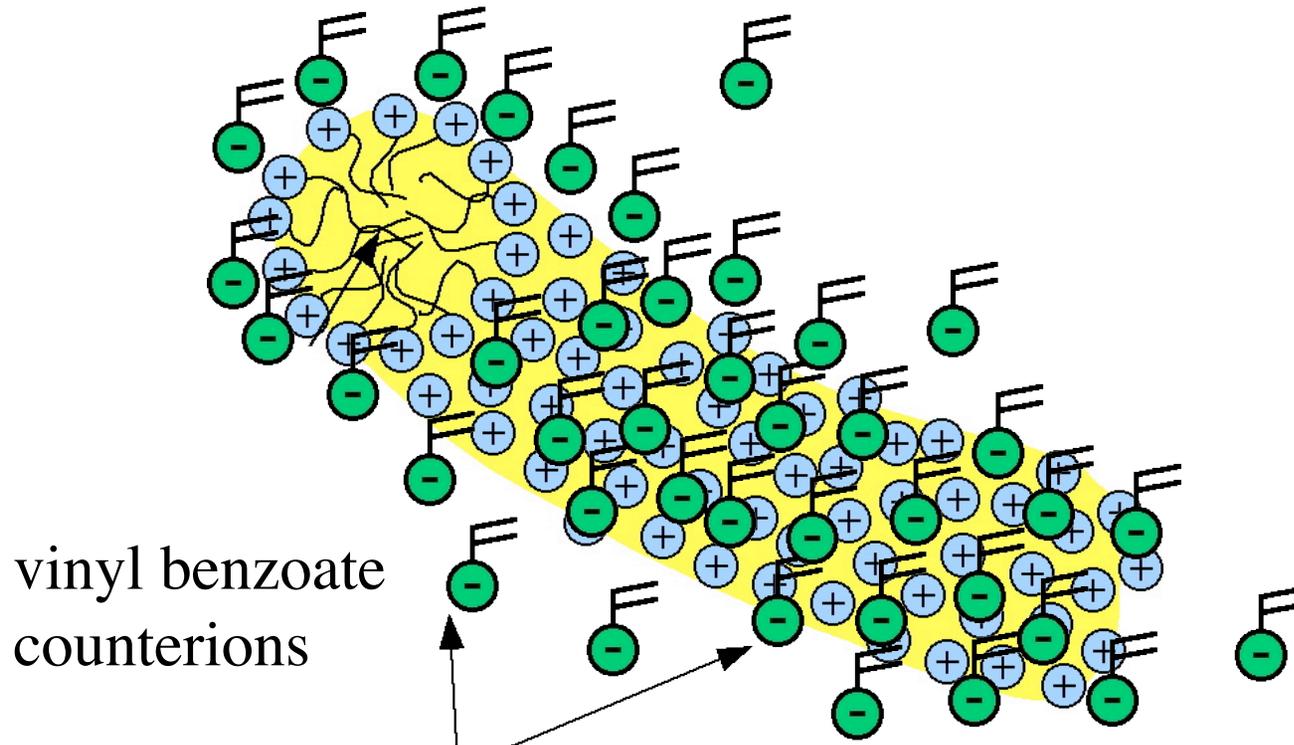
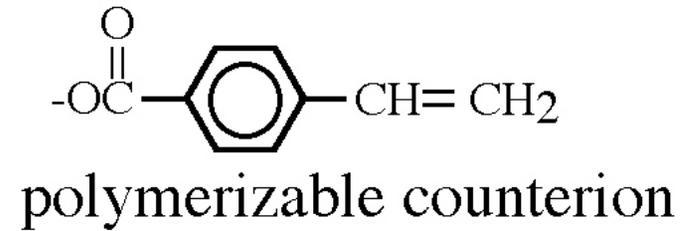
Properties:

Krafft T = 20°C  
CMC = 0.007 wt %  
= 0.16 mM



# Polymerizable Surfactant

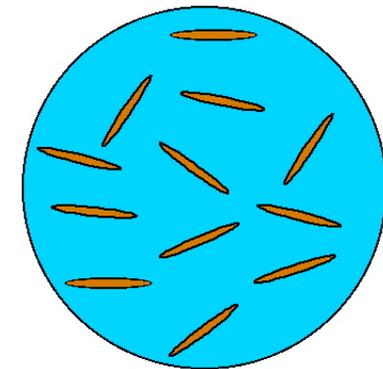
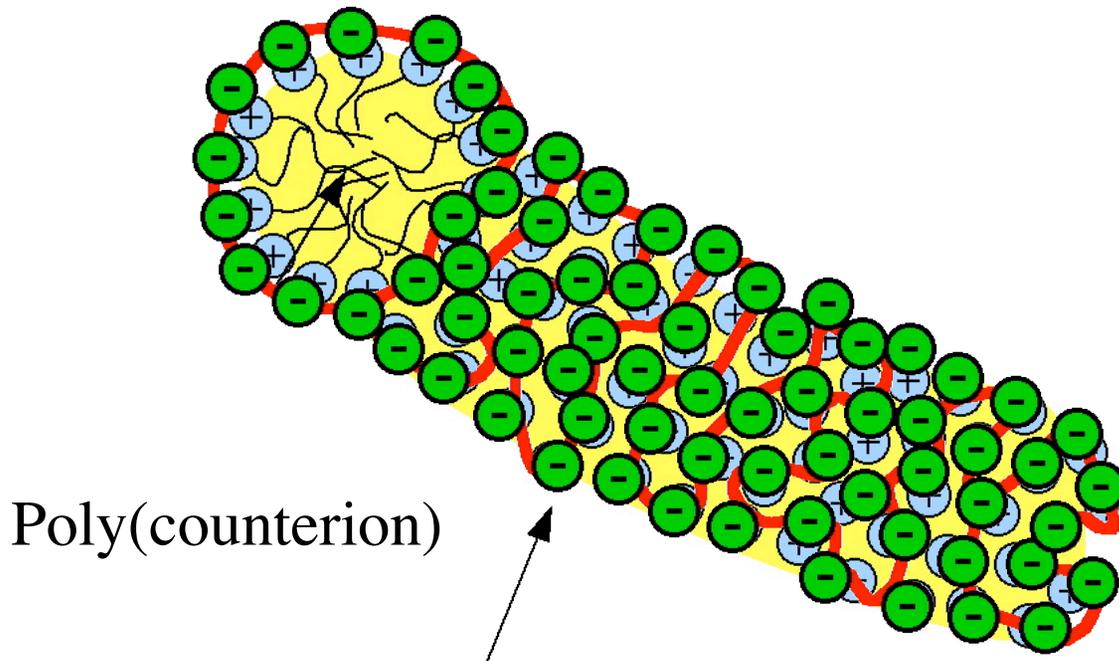
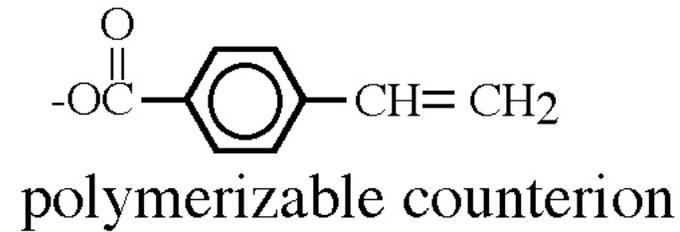
CTVB: Cetyltrimethylammonium 4-vinyl benzoate



- viscoelastic,  
entangled mesh

# Polymerizable Surfactant

CTVB: Cetyltrimethylammonium 4-vinyl benzoate

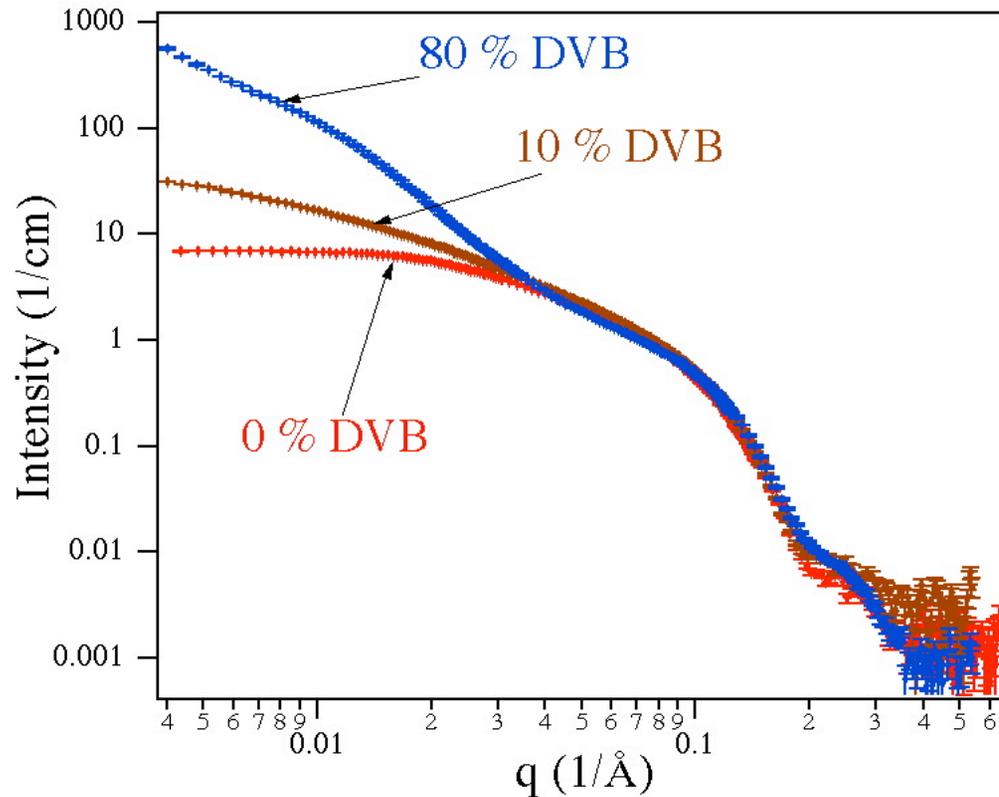


1 wt% surfactant  
98% conversion  
(40 x ~400) Å rods

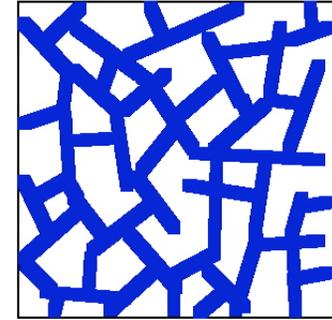
# Crosslinked Micelles



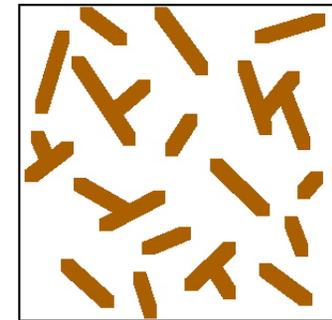
Add divinyl benzene at molar ratios of 0 - 300 %



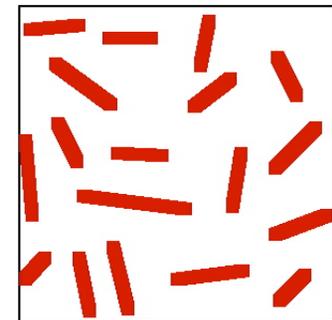
80% DVB



10% DVB

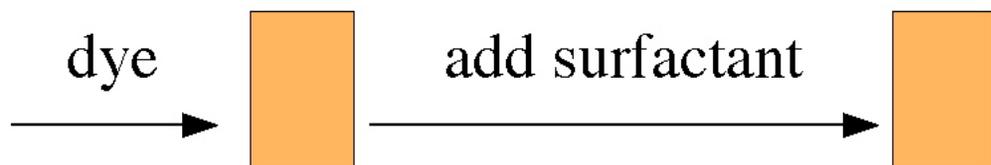


0% DVB

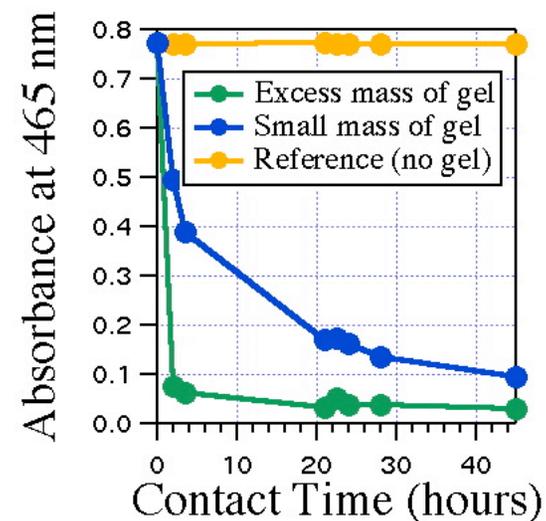


Soft gels are formed at  $> 50\%$  DVB  
1% CTVB : 99% water

# Solubilization of Dye



UV-VIS absorption measurements

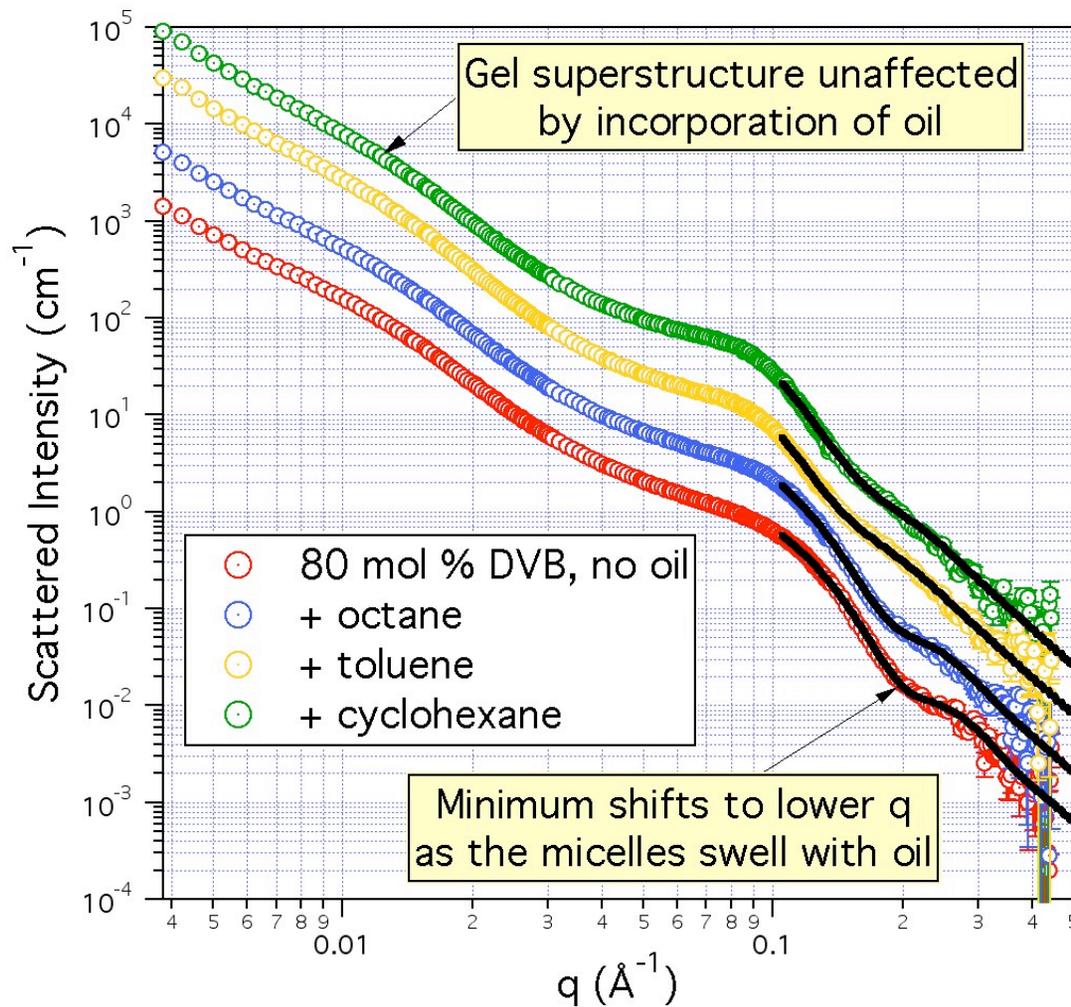


methyl orange -- slightly water-soluble



- Dye concentration is reduced by a factor of 10 in less than 2 hours
- Dye capacity of  $\sim 0.5$  mol dye per mol CTVB

# Solubilization of Oil

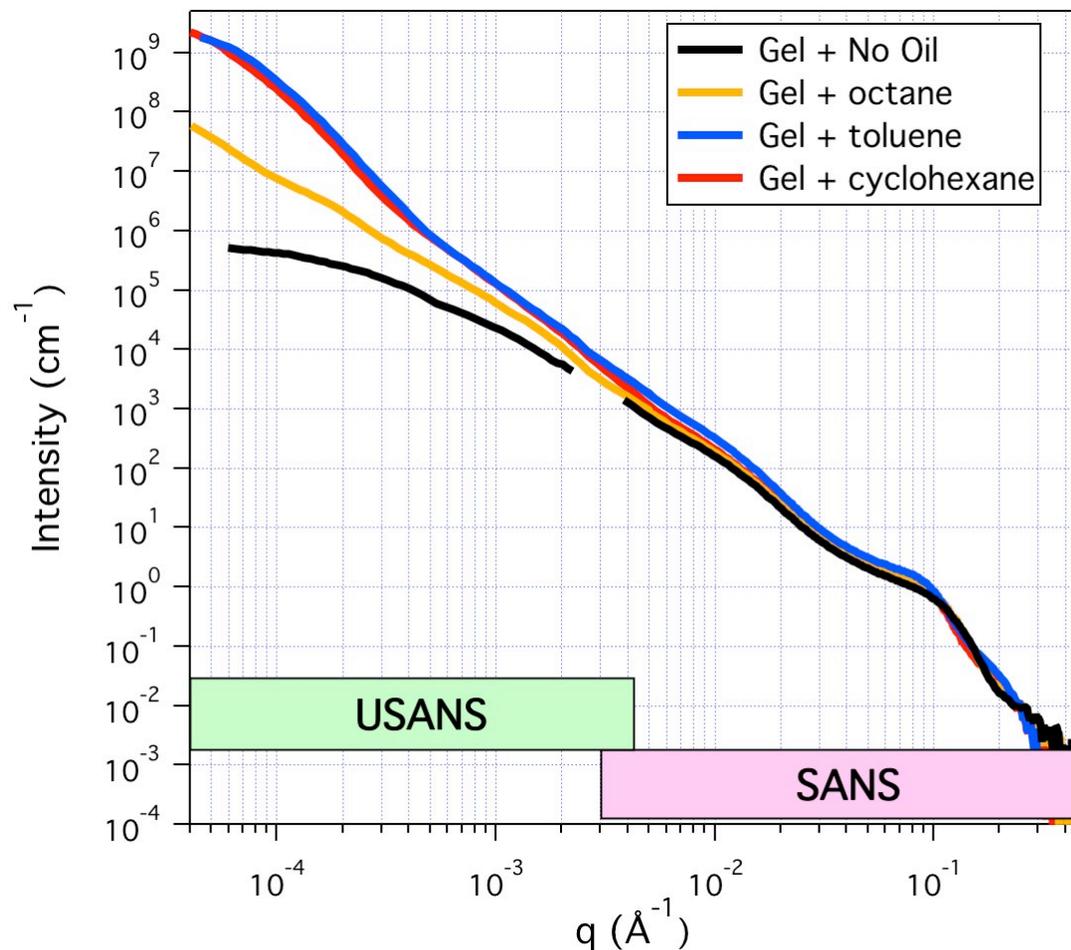


- Hydrogenated gel /  $\text{D}_2\text{O}$
- Radius of cylindrical micelles increases
- From volume increase  $\rightarrow$  find moles of oil relative to surfactant

'Oil Added'	'Radius $\text{\AA}$ '	'Moles Oil'
none	18.5	0.00
Octane	19.5	0.28
Toluene	25.8	3.65
Cyclohexane	24.1	2.66
Naphthalene	18.8	0.12

# USANS - Larger Structures

Gel in D<sub>2</sub>O, hydrogenated oils



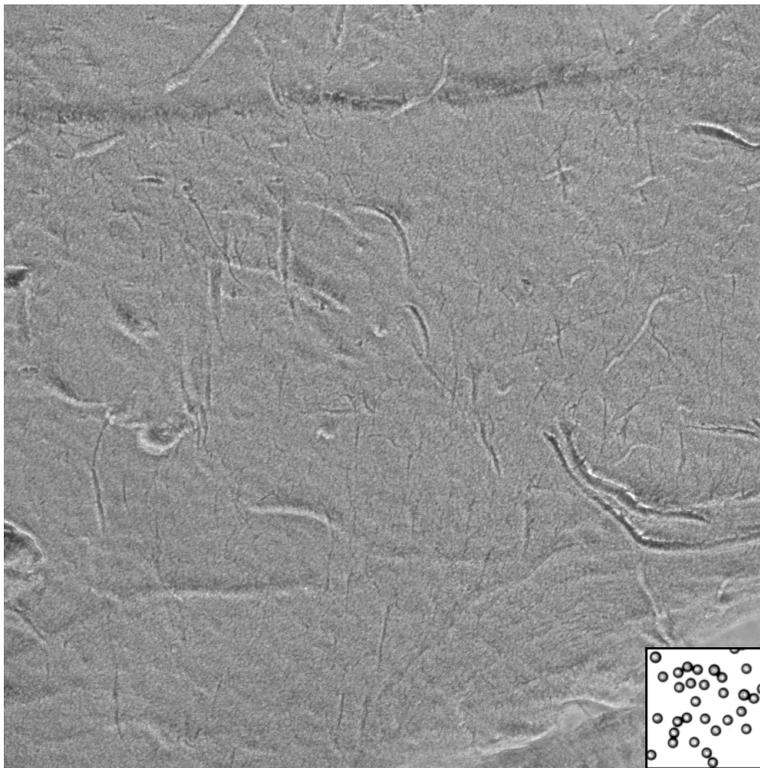
USANS reveals the presence of structures in the gel that are 5 to 10 microns in diameter

Oil	'Rg (μm)'
none	1.4 ± 0.40
octane	4.7 ± 0.15
toluene	2.9 ± 0.05
cyclohexane	3.9 ± 0.01

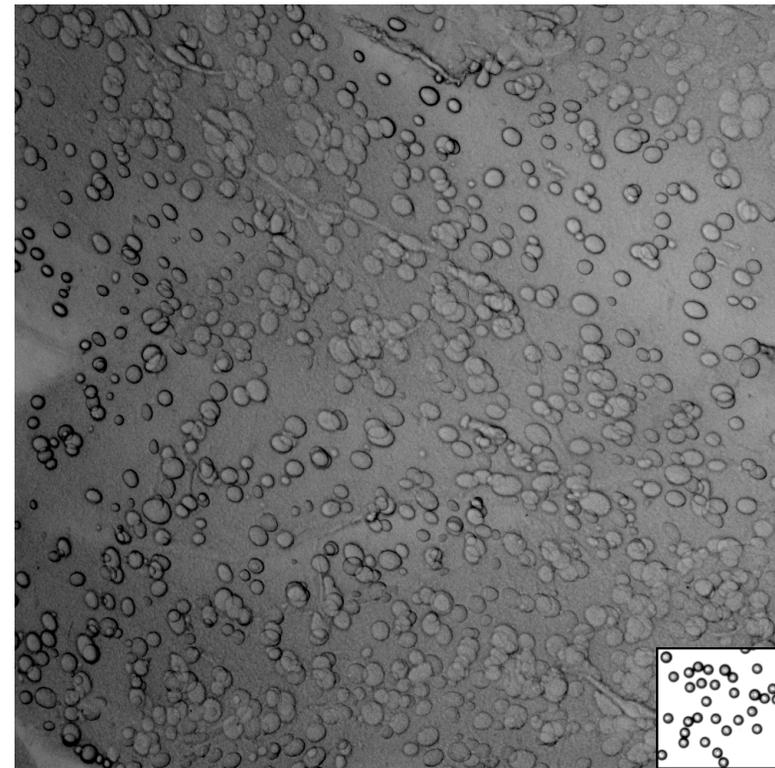
# Microscopy - Large Droplets

Optical microscopy (10x)  
(Inset is 10 micron diameter latex)

Gel, no oil



Gel + toluene

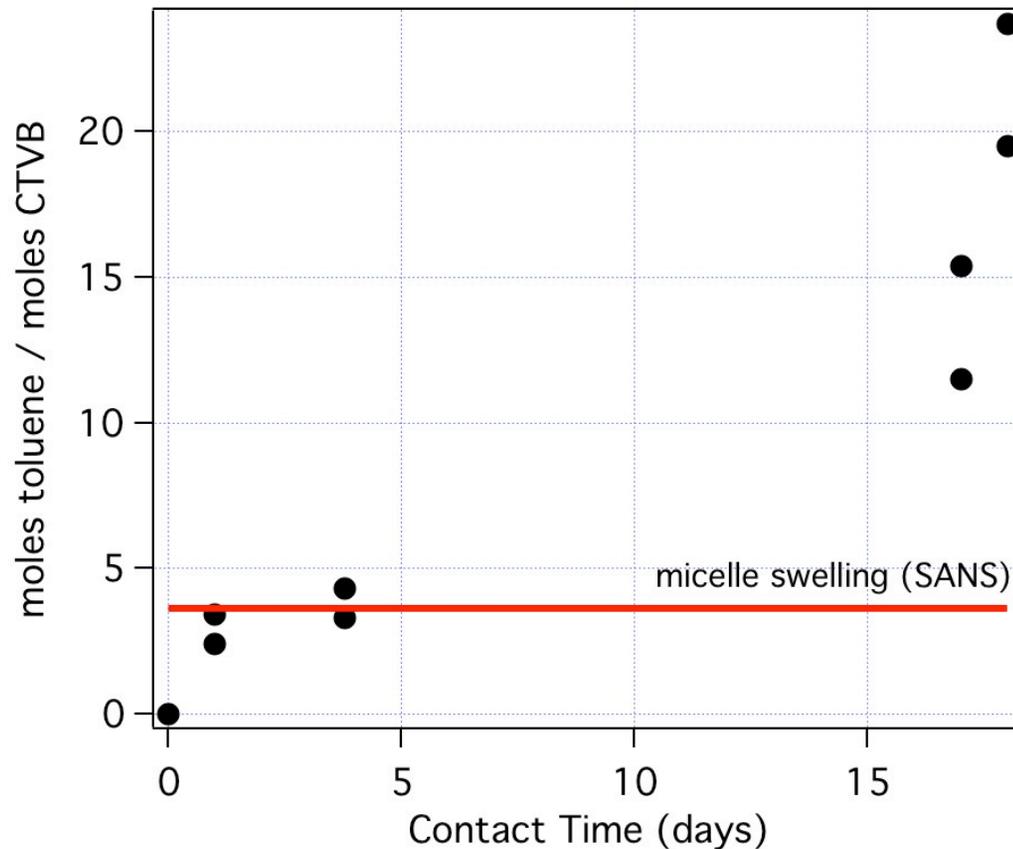
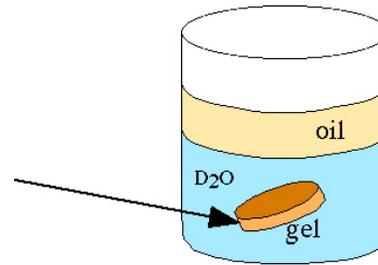


What are the droplets?

# Quantify toluene uptake

Start with a known mass of gel:

- timed exposure to toluene
- extract toluene into methanol
- quantitative UV absorption



It's a slow process! (diffusion, poor water solubility)

Yields toluene volume fraction (~ 4% at 18d)

Kinetics of toluene uptake appears to be very slow...

Need to compare experiments under same exposure conditions

# Experimental Plan

- Expose a series of gel slices in H<sub>2</sub>O to d-toluene
- Measure as a function of time using USANS
  - droplet size (also use optical microscopy)
  - concentration (also use UV spectroscopy)
- What can we learn about the kinetics of solubilization?