

## Soft Matter Exercise - Chapter 7: Gels

### 1. Sol-gel Process

What is the difference between a sol and a gel?

### 2. Gel

You would like to develop a gel that acts as a moisturizer for wounds on the arms and hands, where wounds are frequently subject to compressive and shear stresses.

- What type of gel would you choose and why?
- What material would you use?
- Why does the gel swell if you put it in water?
- How would you tune the gel's mechanical properties?

### 3. Percolating Network

You would like to generate a rigid, percolating network:

- What type of monomers would you use?
- If you have a monomer with 4 neighboring points, how many generations would you have to grow to form at least 1000 bonds, assuming the probability for a bond to form is 0.4?
- If you have a monomer with 2 neighboring points, how many generations would you have to grow to form 1000 bonds, assuming the probability for a bond to form is 0.4?
- You would like to increase the rigidity of the gel without changing the distance between adjacent crosslinks. What would you do?

### 4. Crosslink Rate

In a certain chemical crosslinking reaction involving a monomer that can react at three sites, the degree of reaction,  $f$ , obeys the second-order rate law:

$$\frac{df}{dt} = k(1 - f)^2$$

where the rate constant  $k = 4 \times 10^{-4} \text{ s}^{-1}$ . Calculate:

- the time at which a sol transitions into a gel
- the time after which 75% of the reaction is complete
- the time after which 75% of the monomers are incorporated into the percolating network

### 5. Thermo-Responsive Polymers

Why is poly(N-isopropylacrylamide) (PNIPAM) thermo-responsive?