Gelation of Polymers [pln56]

Gelation taking place in colloidal aggregates of any type is known under the name *sol-gel transition*.

Gelation of polymers in solution involves the formation of a macroscopic network of cross links.

Characterizations of gels:

- structural disorder with randomness in the conformation of polymers and in the positions of cross links,
- rubber-like elasticity and potential for glass transition,
- potential for containing high volume fraction of liquid solvent,
- distinction between *rubbers* (dry gels) and gels proper that contain solvent,
- distinction between *chemical* gels and *physical* gels,
- chemical gels are mostly thermo-irreversible; cross links are formed e.g. by thermo-setting or vulcanisation [psl11],
- physical gels are mostly thermo-reversible; cross links are formed e.g. by micro-crystallisation or microphase separation [psl12].

Percolation model of gelation:

Molecules are represented by points on a lattice. Nearest-neighbor bonds are added randomly with random clusters of growing size emerging. The *percolation threshold* is associated with the appearance of a cluster spanning the lattice.

Some relevant questions:

- What minimum fraction of bonds produces an infinite cluster?
- How does the average cluster size depend on the fraction of active bonds?
- What fraction of bonds belong to the infinite cluster?