Sef-assembly and shape transitions in 2-D polymers

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In biology, self-assembly is fundamental and plentiful. Monomers aggregate linearly to form biopolymers. Two complementary single strands of DNA form a double helix. Lipid molecules spontaneously assemble to form membranes in water. Here we are interested in how supramolecular aggregates such as one and two dimensional polymers are formed from smaller molecules and are distributed in size. Basically, left alone, all processes at a given temperature evolve by competition between energy and entropy under certain constraints to achieve the equilibrium structure in which the free energy is minimized.

Statistical mechanics of the self-assembly and shape transitions of two-dimensional polymers is given tutorially, with an application to the covalently-bonded nanocapsules and films which were recently synthetized. The presence of vacancies, although very minute, is found to play a critical role, in the “irreversible” shape evolution from *a* disk to *a* nanocapsule, as well as in the reversible transitions between *many* capsules and *a* single large film. The implication and applicability of the results to membranes are to be discussed.