Homework 2

Introduction to Macromolecular Physics

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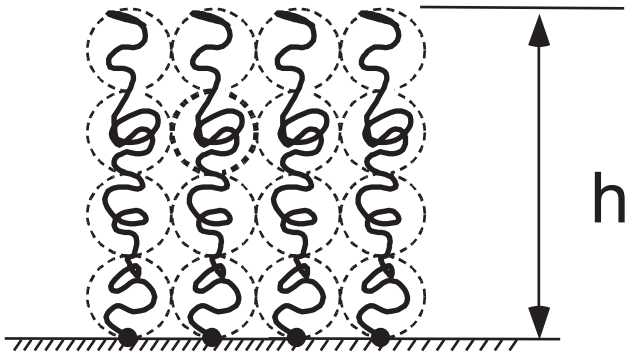
Problem 1: A Polymer Brush



Polymer molecules, each consisting of N segments, are attached to a flat surface and form a so-called *polymer brush*. The density of attachment points (anchor points) on the surface is σ [points / cm^2]. Use the picture of blobs to find an expression for the thickness h of the brush as a function of a, N and σ!

Hint: The brush can be considered as a dense package of blobs; the configuration of each chain is strongly elongated (straight line of blobs), see Fig. above.

Problem 2:

For $x > R_F$ the end-to-end distance distribution of a polymer chain described by the model of a self-avoiding random walk behaves as

$$p(N) \propto \exp\{-A(x/R_F)^{\delta}\}. \tag{1}$$

On the other hand, for large elongations the elastic force on a polymer chain using the blob model was obtained to be

$$f \propto x^{\frac{\nu}{1-\nu}}. \tag{2}$$

Find the relation between δ and ν by comparing these two results.

Hint: Calculate the free energy F from $p(N)$ and use it for evaluating the force. Compare this expression with the one from the blob model.