Polymer-Elasticity

System requirements

Necessary Programs

- Matlab (= 2019a)
- Python (= 3.7)

Necessary Matlab Apps

- Kraftkurven.mlapp

Necessary Matlab Scripts

- Polymer_elasticity (>= 2)

Necessary Librarys

- Utility Function Library

General Information

The polymer-elasticity script can be used to fit the model of the extended, freely jointed chain to results of force-clamp experiments (and only this functionality has been designed for this script). The model is as follows [1, 2]:

$$Ex(F) = L_C \cdot \left\{ \coth\left(\frac{F \cdot l_K}{k_B \cdot T}\right) - \frac{k_B \cdot T}{F \cdot l_K} \right\} \cdot \left(1 + \frac{F}{K_S \cdot l_K}\right)$$

Where $Ex(F)$ represent the force-dependent expansion of the measured molecule and F represent the force applied in z-direction to the molecule. The free parameters of the model are

- K_S: Segment-Elasticity in Nm^{-1}
- L_C: Contour-Length in m
- l_K: Kuhn-Length (Monomer-Length) in m

The constant Parameters are the Boltzmann constant k_B as well as the absolute Temperature T.

This model is fitted to the plotted inverse function (path vs. force) at the data range selected in polymer_elasticity.

Execution of the Program

Before starting the program, the following points must be met:

- • The Utility Function Library must persist on the MATLAB path
- • A Python interpreter must have been determined in Matlab (see Matlab documentation on pyversion)

Execution of the program start:

1. Create the DataSelection variable using the app *Kraftkurven*
    a. Open *Kraftkurven* using the Load button
    b. Close all Matlab Figure tools
    c. Right-click on any graph --> *Graphen Staffeln*
    d. Right-click on a specific graph --> open graph in new image

e. Close all Figure tools in the new window
f. Right-click on the free area around the graph
g. Select a specific selection type and mark the data
h. Right-click on the selected data area --> To Workspace

2. Start the *polymer_elasticity* script by clicking on the Run button in the Matlab editor or by pressing the F5 key while the Matlab editor is activated

User Guide

Further information can be found in the help tab on the slide panel (the panel with the character ">>").

References

[1] A. Janshoff, M. Neitzert, Y. Oberdörfer, and H. Fuchs, “Kraftspektroskopie an molekularen Systemen: Einzelmolekülspektroskopie an Polymeren und Biomolekülen,” *Angewandte Chemie (International ed. in English)*, no. 112, pp. 3346–3374, 2000.

[2] M. I. Giannotti and G. J. Vancso, “Interrogation of single synthetic polymer chains and polysaccharides by AFM-based force spectroscopy,” (eng), *Chemphyschem : a European journal of chemical physics and physical chemistry*, vol. 8, no. 16, pp. 2290–2307, 2007.