Microfluidic probing of the complex interfacial rheology of multilayer capsules.

Corentin Trégouët, Thomas Salez, Cécile Monteux and Mathilde Reyssat

Supplementary information

The objective of this note is to show that $E_\gamma = \Pi$ ($E_\gamma$ and $\Pi$ being respectively the surface dilational elastic modulus and the surface pressure) in the case where the polymer chains remain adsorbed at an interface during a compression event (no chain desorption).

In the case of an interface covered by some polymer chains, the surface tension $\gamma$ is reduced compared to the bare interface of surface tension $\gamma_0$ as follows:

$$\gamma = \gamma_0 - \alpha N k_B T \Gamma$$

(1)

with $k_B$ and $T$ the Boltzmann constant and temperature, $\alpha$ and $N$ the grafting degree and the length of the grafts, and $\Gamma$ the surface concentration of polymers (number of chain per unit area).

The surface pressure defined as $\Pi = \gamma_0 - \gamma$ reads:

$$\Pi = \alpha N k_B T \Gamma .$$

(2)

Writing $\Pi_i$ and $n_i$ the initial surface pressure and initial number polymer chains, and $A$ and $A_i$ the area and initial area respectively, the previous equation becomes:

$$\Pi = \alpha N k_B T n_i A_i,$$

(3)

$$\Pi = \Pi_i \cdot \frac{A_i}{A} .$$

(4)

Given that the surface dilational elastic modulus $E_\gamma$ is defined as follows:

$$E_\gamma = -\frac{d\Pi}{d(\ln A)},$$

(5)

the previous equations lead to the following identity:

$$E_\gamma = \Pi .$$

(6)