

Microfluidic probing of the complex interfacial rheology of multilayer capsules.

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Supplementary information

The objective of this note is to show that $E_\gamma = \Pi$ (E_γ and Π 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 γ is reduced compared to the bare interface of surface tension γ_0 as follows:

$$\gamma = \gamma_0 - \alpha N k_B T \Gamma \quad (1)$$

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

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

$$\Pi = \alpha N k_B T \Gamma . \quad (2)$$

Writing Π_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:

$$\Pi = \alpha N k_B T \frac{n_i}{A} , \quad (3)$$

$$\Pi = \Pi_i \cdot \frac{A_i}{A} . \quad (4)$$

Given that the surface dilational elastic modulus E_γ is defined as follows:

$$E_\gamma = - \frac{d\Pi}{d(\ln A)} , \quad (5)$$

the previous equations lead to the following identity:

$$E_\gamma = \Pi. \quad (6)$$