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Controlling the rheology of a solid emulsion with liquid droplets

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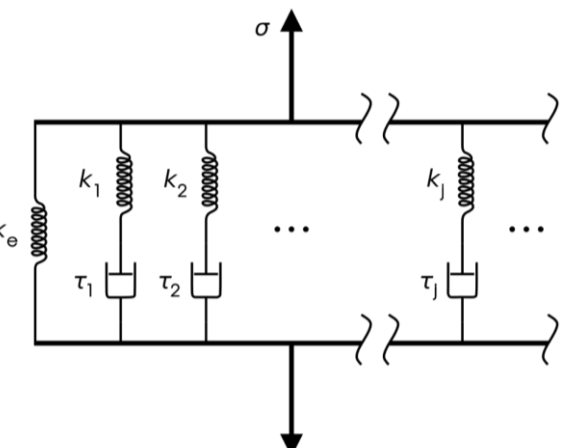
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Motivation

Usual viscoelastic materials: coupling of elasticity and viscosity



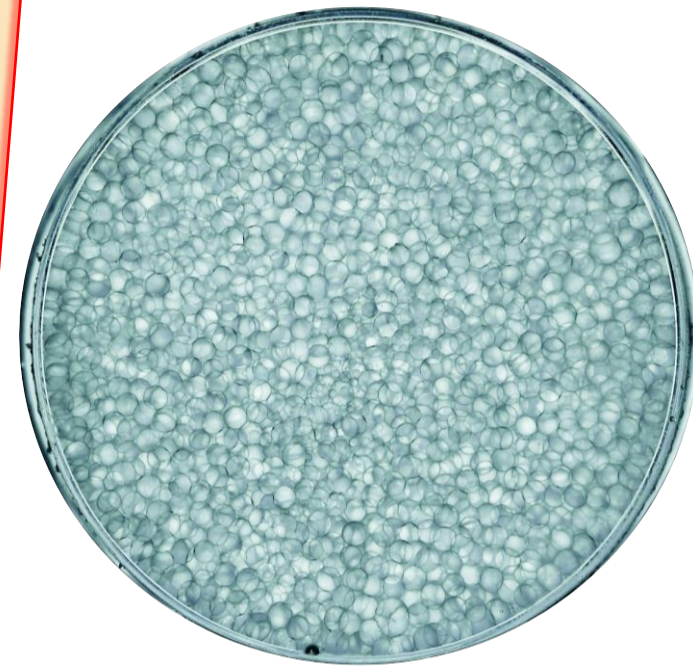
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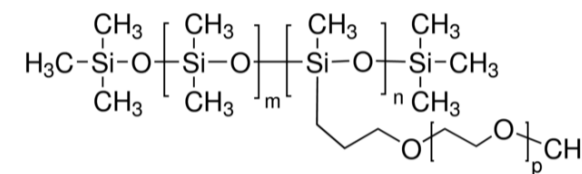
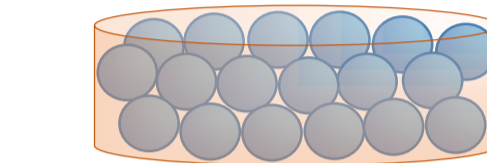
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Decorrelation of a composite's storage and loss moduli

Sample



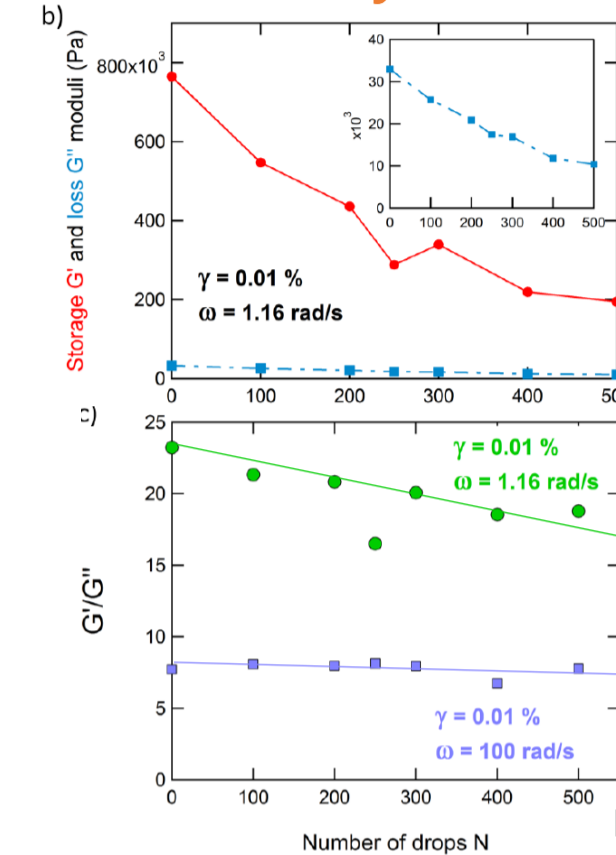
- Solid continuous phase, elastic (PDMS)
- Liquid dispersed phase, Newtonian fluid (PEG)
- Surfactant: block copolymer



Generation methods:

- Breakup under shear (control over Φ)
- Millifluidic (control over R)

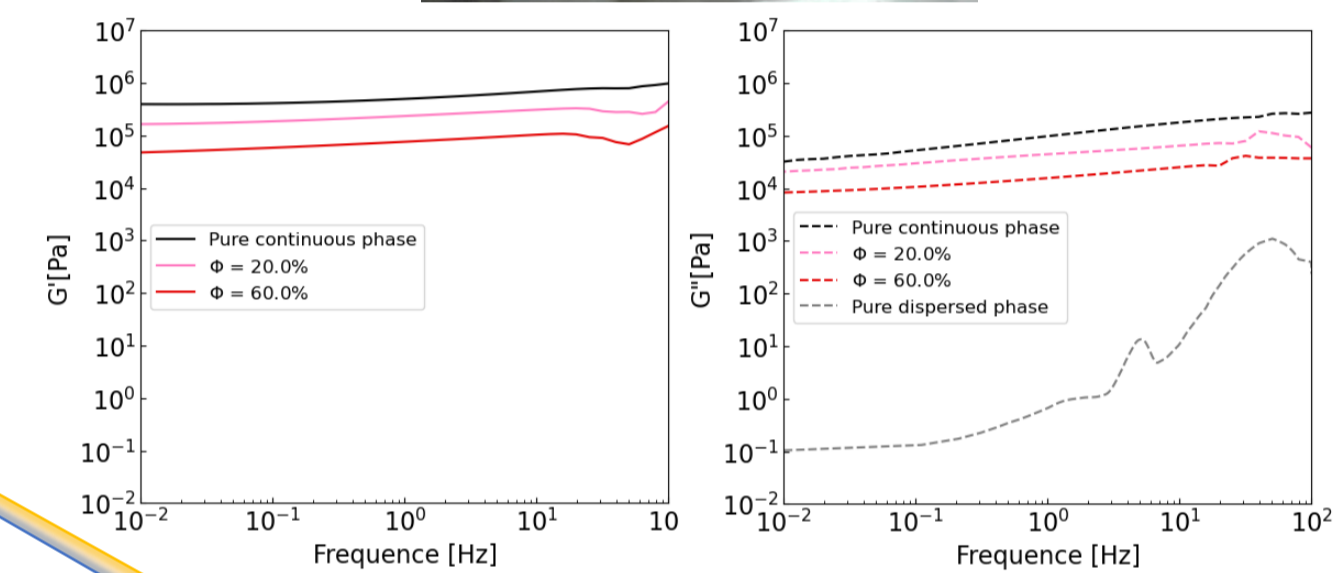
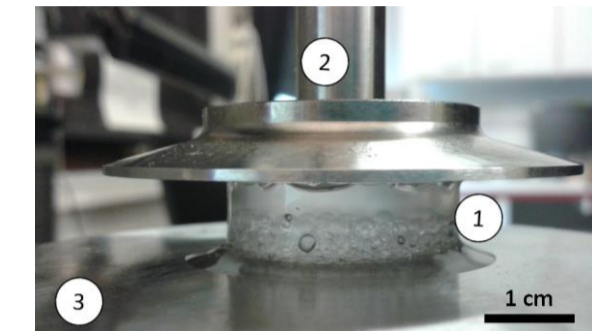
Preliminary results



From [1]

What key parameters to observe a larger variation?

Results: Frequency sweep

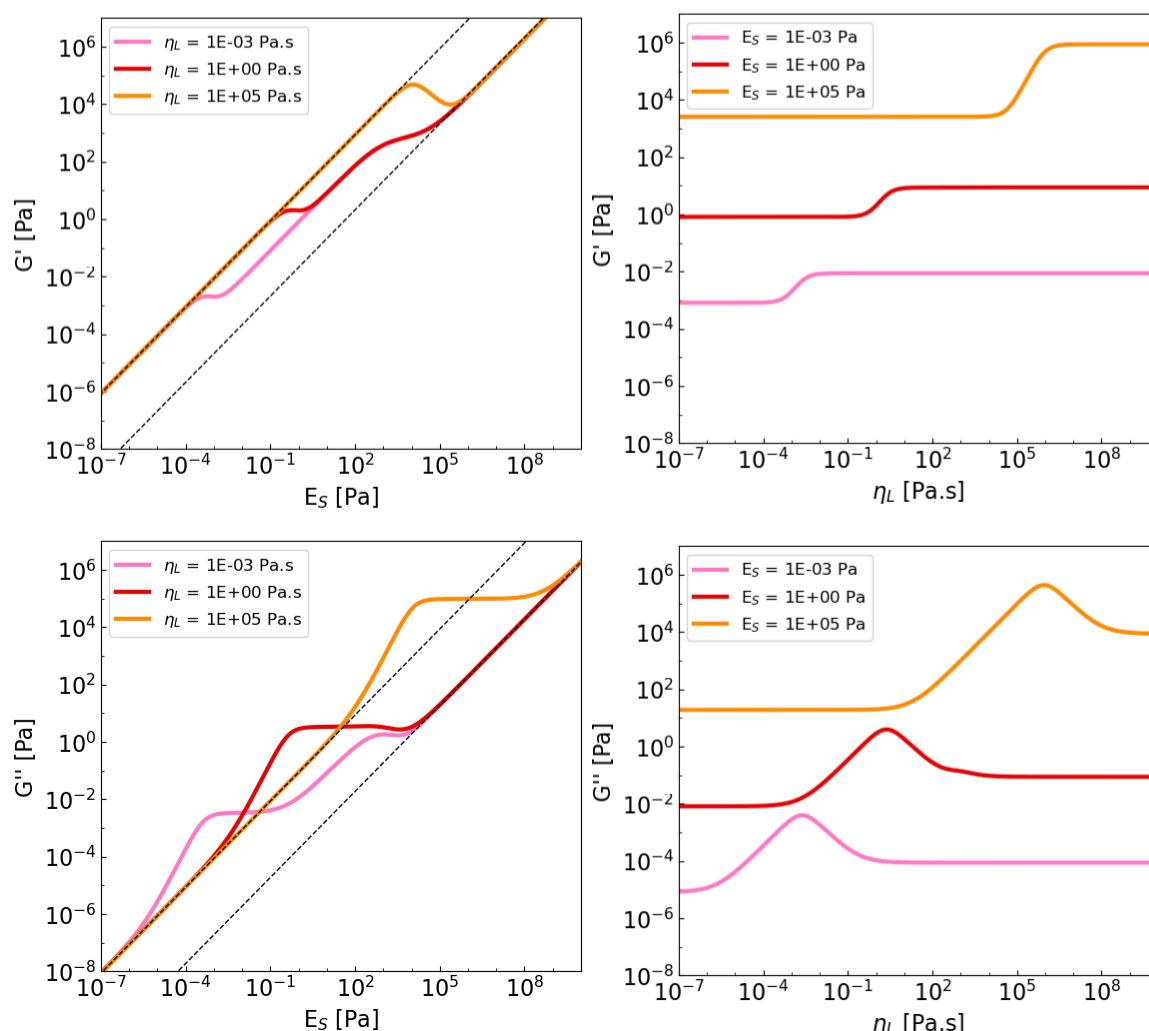


Palierne model for polymer blends: [2]

$$H^* = \frac{(G_d^* - G_m^*)(19G_d^* + 16G_m^*) + 4\sigma/R(5G_d^* + 2G_m^*)}{(2G_d^* + 3G_m^*)(19G_d^* + 16G_m^*) + 40\sigma/R(5G_d^* + 2G_m^*)}$$

$$G^* = G_m^* \frac{1 + 3\Phi H^*}{1 - 2\Phi H^*}$$

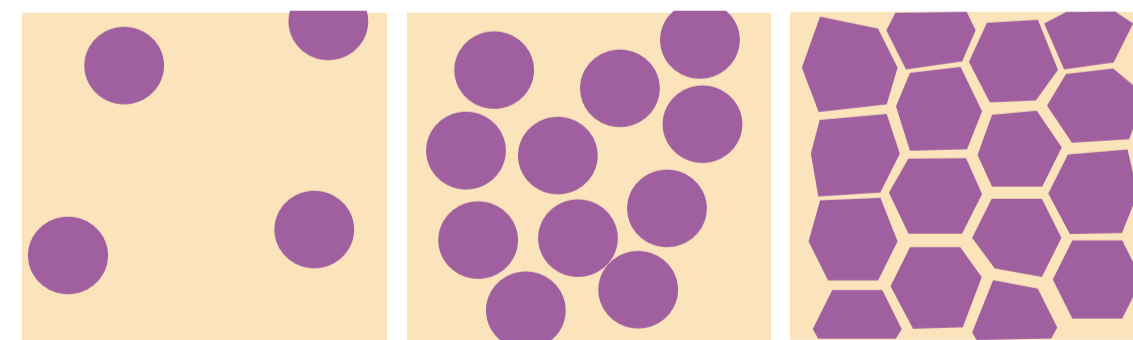
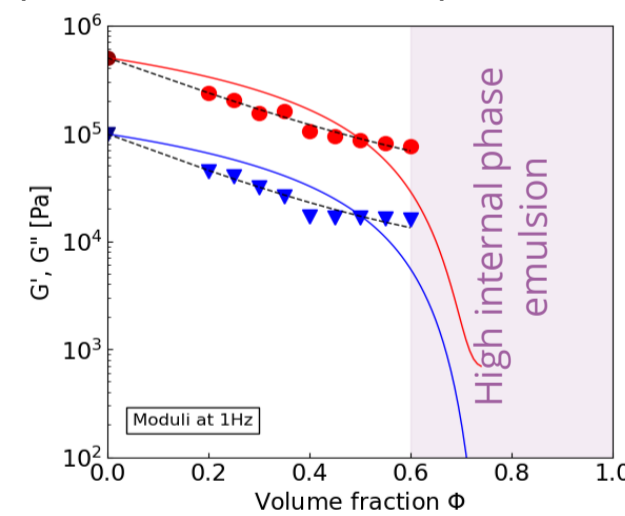
Moduli of our emulsion as defined by Palierne



- G^* : modulus of the composite
- G_d^* : modulus of the dispersed phase
- G_m^* : modulus of the matrix
- σ : surface tension
- R : average radius of the droplets
- Φ : volume fraction

Results: Effect of volume fraction

Unexpected behavior compared to Palierne

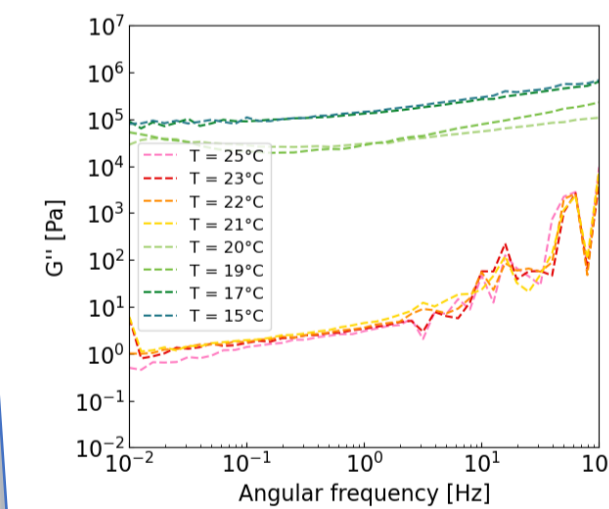


0,3

0,6

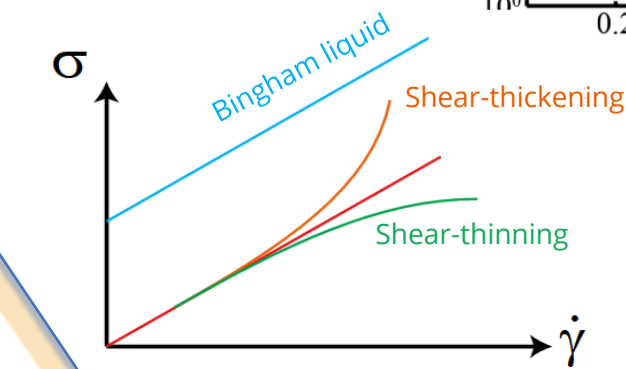
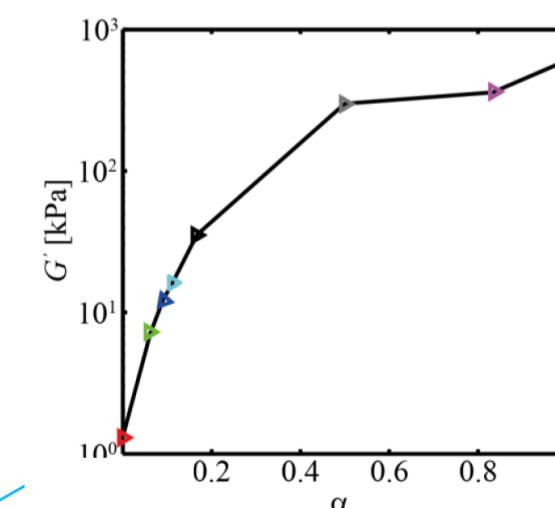
Volume fraction

Perspectives



Dynamical properties of PEG600 with temperature

Storage modulus of mixtures of PDMS



Non-Newtonian drops?

From [3]

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