LINEAR VISCO-ELASTICITY OF ENTANGLED WORMLIKE MICELLES BRIDGED BY TELECHELIC POLYMERS: AN EXPERIMENTAL MODEL FOR A DOUBLE TRANSIENT NETWORK

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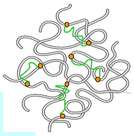
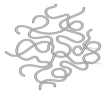
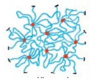
MOTIVATION



2 experimental paradigms of aqueous transient self-assembled networks



Entangled Wormlike Micelles (WM)



Telechelic Chains

Maxwell Fluids

WM bridged by telechelic copolymers

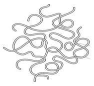
Two coupled transient networks

1) Entanglements of WM

2) Sliding junctions of telechelic polymers

EXPERIMENTAL SYSTEM

Cetylpyridinium Chloride + brine (NaCl 0.5M) + NaSal



+

Home-synthesized **telechelic polymers**

« 2-stickers » polymer

$C_{18} – PEO_{10K} - C_{18}$ (R_G = 37 Å)

2 parameters:

$\beta = \frac{n_{sticker}}{n_{surf.}}$

ϕ surfactant cc (control the mesh size ξ)

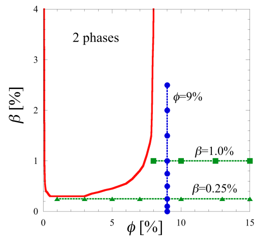
For comparison

Amphiphilic copolymers

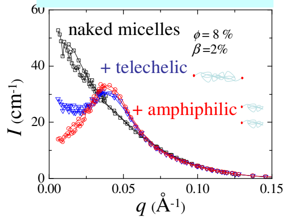
« 1-sticker » polymer

C_{18} - POE_{5K} (R_G = 24 Å)

Phase-Diagram



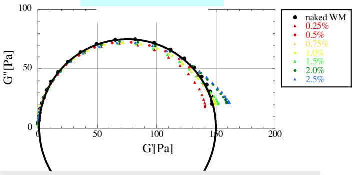
Structural Properties



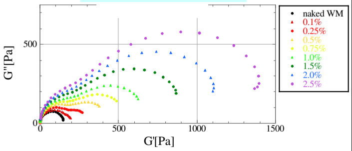
Ramos and Ligoure, Macromol., ***40****, 1248-1251 (2007)*

COMPARISON HAIRY/BRIDGED WORMLIKE MICELLES

Hairy WM



Bridged WM



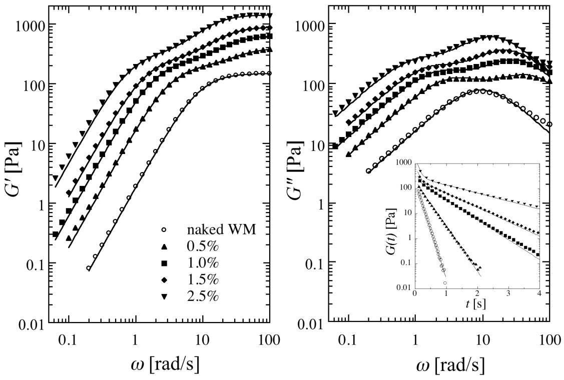
Maxwell Fluids !
Almost no effect of the addition of amphiphilic polymers

Bridged and Entangled WM: a two Maxwell fluid blend

ANALYSIS

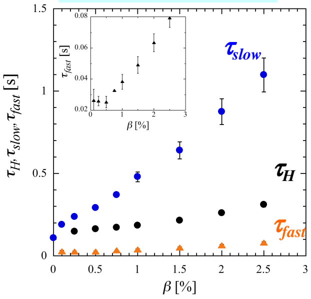
the 2 modes are coupled

Fit of the data with the sum of two Maxwell modes

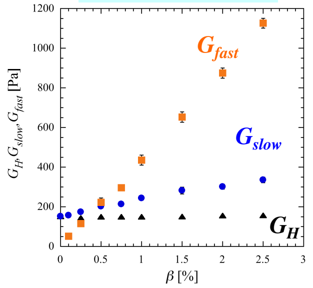


4 parameters : G_{fast}, τ_{fast}, G_{slow}, τ_{slow}

Relaxation times



Plateau moduli



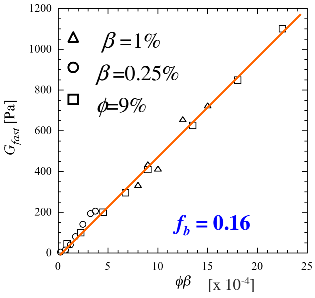
G_{fast} varies **linearly** with the amount of telechelic chains (transient network theory)

$G_0 = \mu k_B T$

density of active chains $\sim \phi \beta f_b$

f_b = [bridges] / {[bridges] +[loops]}

No percolation threshold !!



collapse of all data

f_b independent of surfactant cc (i.e. independent of the mesh size)

Because of sliding junctions ?

CONCLUSION

- **Slow mode** associated with the transient network of WM
  Relaxation understood (**breakable reptation + sticky reptation**)

- **Fast mode** associated with the network of telechelic chains
  Well described by the **transient network theory**:
  G_{fast} ~ density of **active** chains.
  τ_{fast} :~ amount of telechelics (**due to the topology of the network?**)