Homework 10
Polymer Physics 2023
Due Tuesday March 28 at noon
(Please send one email with a **pdf** attachment to beaucag@uc.edu
The file should be called: **HW 8 Group x Last Name_Name_Name_Name.pdf**)

Qiao H, Zheng B, Zhong G, Li Z, Cardinaels R, Moldenaers P, Lamnawar K, Maazouz A, Liu C, Zhang H *Understanding the Rheology of Polymer-Polymer Interfaces Covered with Janus Nanoparticles: Polymer Blends versus Particle Sandwiched Multilayers* Macromolecules **56** 647-663 (2023) describe dumbbell-shaped Janus particles that are used as a Pickering emulsion to control the dynamic properties of a polystyrene/polymethylmethacrylate polymer blend in bulk melt blends and in layered structures, the latter removing curvature effects on the dynamic properties.

a) Figure 7 shows the storage and loss moduli for several concentrations of Janus particles. The data is obtained by SAOS and from creep measurements to extend the data to very low frequency using the Schwatzl method [49]. Explain how this broad range is usually obtained using time-temperature superposition and how Qiao has achieved this using creep measurements. What is the shoulder at low frequency in G'? Why does it change with concentration of Janus particles? What is the "*subtle increment in the terminal region*" that Qiao discusses?

b) Equation 3 gives the generalized Palierne model that describes the bulk and disperse phase dynamics and the dilatational and shear interfacial dynamics. Describe the Marangoni stress and the other components that contribute to the Palierne model. Why is the Marangoni effect not present in layered structures?

c) Figure S6 in the supporting information shows Cole-Cole plots for the PS/PMMA blend and for blends with Janus particles. Explain what a Cole-Cole plot is and what can be inferred from these two plots.

d) Figure 9 and Figure S8 show the weighted relaxation spectra, $\tau H(\tau)$, which show peaks associated with the form relaxation and the interfacial relaxation (compare with neat polymers shown in figure S9). Explain how the relaxation spectra relate to the storage and loss moduli. Why is the relaxation spectrum easier to understand compared to the moduli? Figures 9 e and f show the dynamics of a co-continuous structure. Explain the difference between 9 e and f and 9 a to d.

e) Explain the origin of equations 12 and 13 (as done in class) and how they are used to show that Figure 12 differs from figure 9. Why do multilayer structures show different dynamic behavior compared to bulk mixed samples?