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Helical Twist in Xanthan Lyotropic Liquid Crystalline Solutions: Temperature and Concentration Dependence

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To mitigate climate change, increasing research efforts are focusing on addressing the urgent requirement for sustainable functional materials derived from nature. In our previous work,[1] we reported that structurally colored films can be simply prepared from ultrasonically treated xanthan aqueous solutions, a biopolymer sourced from the bacteria *Xanthomonas campestris*, by subsequent water evaporation. A key factor which determines the photonic properties of the dried xanthan films is the helical pitch p in the solid cholesteric structure retained from the liquid crystal phase, which enables the films to selectively reflect visible light.

To elucidate the pitch development from the ultrasonically treated xanthan solutions to the dried films, we have extended our study of the concentration dependence of p up to high mass fractions. By comparing the data with different theoretical and empirical models, we noted that the pitch evolution in the studied systems cannot be explained by any theoretical model up to date, but can only be modeled with an empirical power law. Furthermore, we will demonstrate a systematic temperature dependence investigation of p in xanthan solutions with different chain lengths, depicting that p is gradually unwound with increasing temperature. Additionally, it is noticeable that the helical twist $1/p$ shows a strongly linear dependence on temperature, which can be correlated with the semiflexible xanthan chains and is not observed in rigid cellulose nanocrystal suspensions,[2] another main source for sustainable photonic film fabrication.

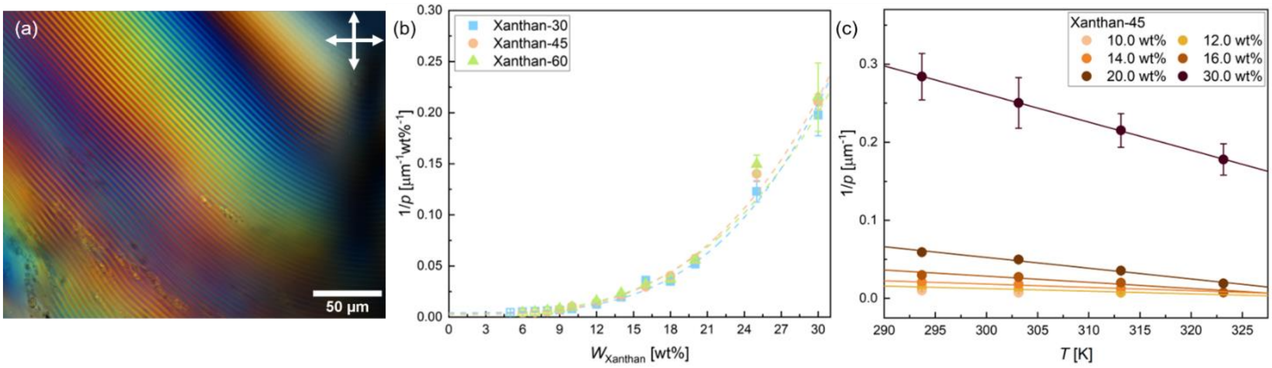

Figure 1. (a) Finger print texture (25.0 wt%) of treated xanthan in aqueous solutions (image taken between crossed polarizers). (b) Helical twist 1/p in Xanthan-X solutions (X: ultrasonic treatment time in minutes) against the xanthan mass fraction W with a power law fit to the experimental data in the fully anisotropic phase.[3] *(c) Linear change of helical twist 1/p in xanthan-45 solutions with temperature T.*[4]

References

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