GRAPHENE AND 2DM VIRTUAL CONFERENCE & EXPO

Graphene online 2020 October 19-23

Hybrid molecular/mineral lyotropic liquid crystal system of CTAB and graphene oxide in water

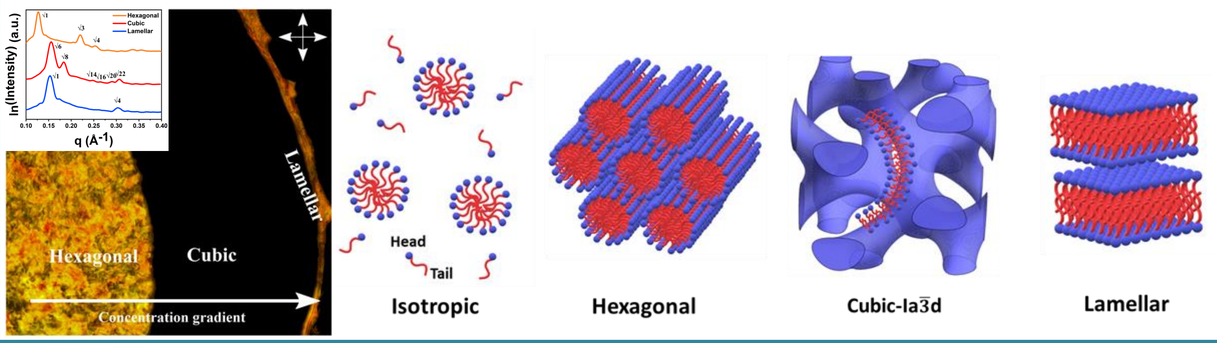
Shao Yizhen[1]; Ingo Dierking[2*], Aravind Vijayaraghavan[1*]

[1]Department of Materials, The University of Manchester, Manchester, M13 9PL, UK

[2]Department of Physics and Astronomy, The University of Manchester, Manchester, M13 9PL, UK

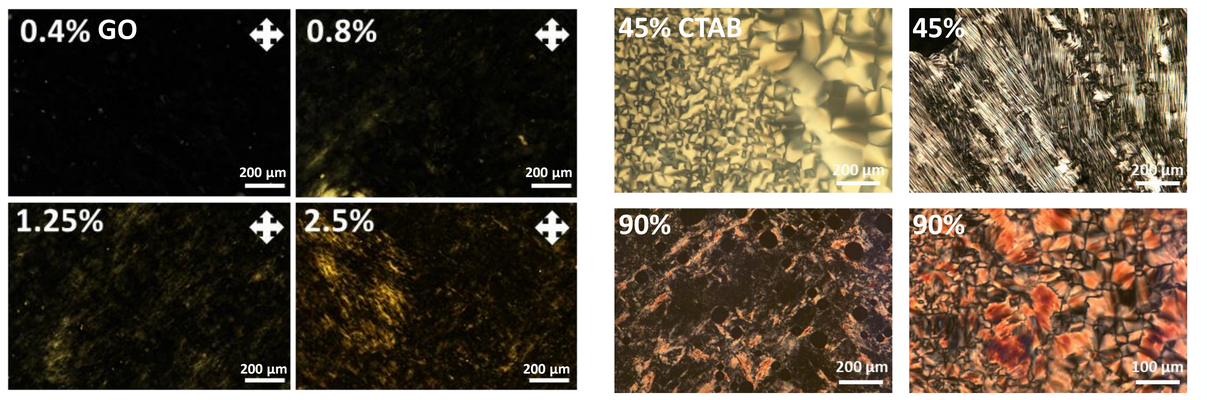
Introduction and Motivation

Amphiphilic molecules such as cetyl trimethylammonium bromide (CTAB) and minerals such as graphene oxide (GO) self-assemble to form lyotropic liquid crystal (LLC) systems in water[1,2]. The combination of amphiphilic molecular LCs and GO LCs offers great potential for designing and producing hybrid nanostructured materials.



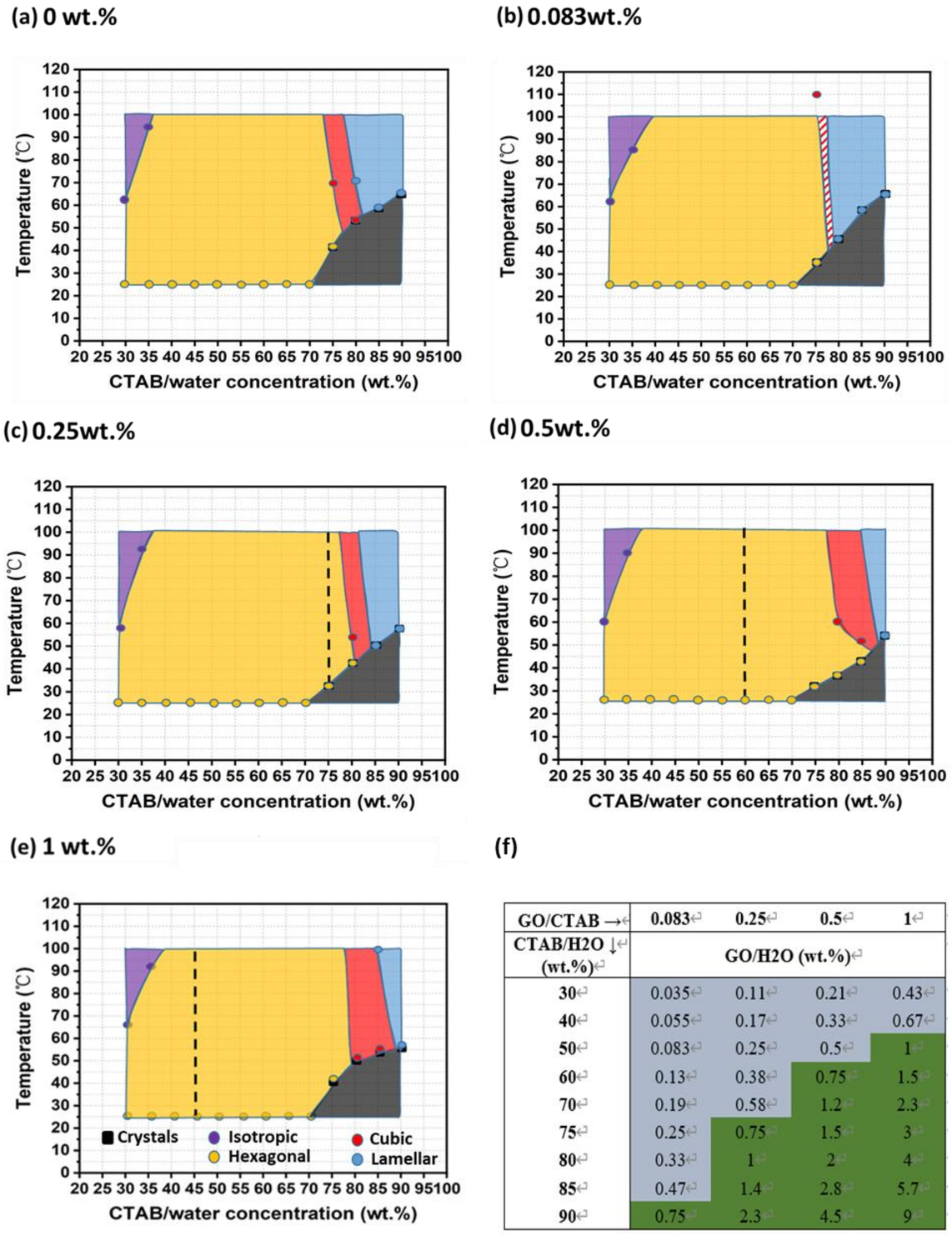
Textures of GO and CTAB LLCs

GO dispersions and CTAB solutions were mixed by different ratios to prepare CTAB/GO LLCs. The LLC texture was characterised in sealed glass cells with a polarized optical microscope (POM).



LLC phase diagrams of CTAB/GO/water ternary systems

GO either promotes or suppresses the formation of the different LLC phases of CTAB depending on the concentration of GO and whether the GO itself is in its isotropic or lyotropic phase, resulting in the formation of a complex hybrid system.



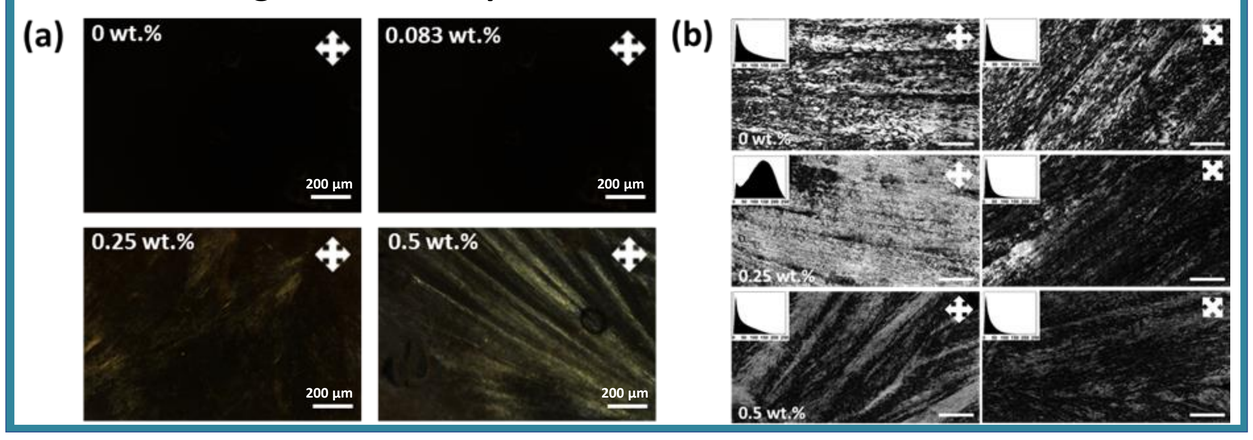
GO/CTAB →	0.083	0.25	0.5	1
CTAB/H2O ↓ (wt.%)	GO/H2O (wt.%)			
30	0.035	0.11	0.21	0.43
40	0.055	0.17	0.33	0.67
50	0.083	0.25	0.5	1
60	0.13	0.38	0.75	1.5
70	0.19	0.58	1.2	2.3
75	0.25	0.75	1.5	3
80	0.33	1	2	4
85	0.47	1.4	2.8	5.7
90	0.75	2.3	4.5	9

The dashed red region in (b) refers to a speculated existence of a narrow cubic zone due to the observed data point at 75 wt.% at 110 ℃. The dashed vertical lines in (c), (d) and (e) refer to the GO LC transition point.

GO nematic/CTAB hexagonal interpenetrating LLC structures

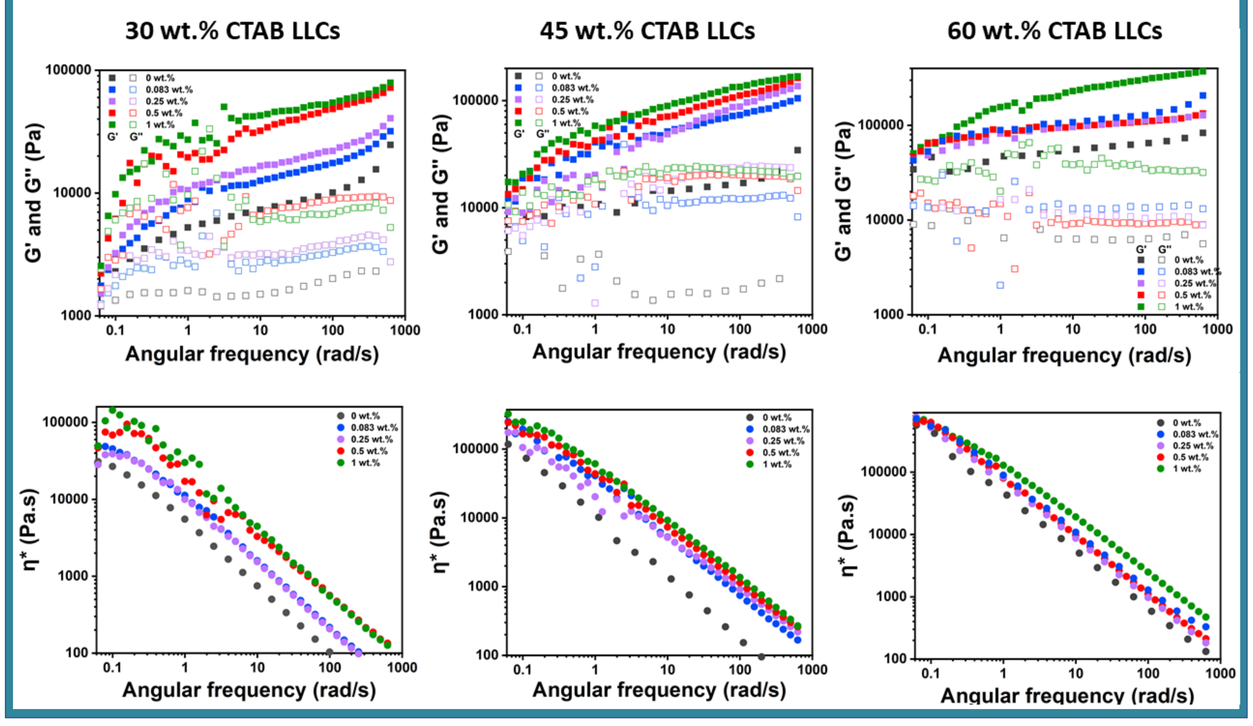
(a) At low GO content of about 80 wt.% CTAB, only the cubic Ia$\bar{3}$d phase of CTAB exists. But for the systems with higher GO content, LLC textures of GO are observed, indicating the co-existence of GO LLCs within the cubic phase.

(b) The significant light attenuation implies a more uniform alignment of LLCs throughout the sample.



Rheological behaviour of CTAB/GO/water LLCs

The elastic properties of CTAB/GO/water system are significant enhanced by increasing GO loading, as the GO sheets strongly increase the interactions within the LLC microstructure.



Conclusions

The results give a comprehensive understanding of hybrid colloidal systems incorporating both molecular and mineral lyotropic systems, and reveals the versatile potential to tailor these novel self-assembled materials.

CONTACT PERSON

e-mail:

yizhen.shao@postgrad.manchester.ac.uk

ingo.dierking@manchester.ac.uk

aravind@manchester.ac.uk

REFERENCES

[1] Dierking, Ingo, and Shakhawan Al-Zangana. "Lyotropic liquid crystal phases from anisotropic nanomaterials." Nanomaterials 7.10 (2017): 305.

[2] Y. Shao et al. "Hybrid molecular/mineral lyotropic liquid crystal system of CTAB and graphene oxide in water." (*Submitted*)

Graphene online 2020