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

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Self-assembled colloidal systems have potential to form novel nanostructures when combined with 2-dimensional materials[1]–[4]. Here we present the preparation, structures and mechanical properties of a hybrid lyotropic LC system comprised of cetyl trimethylammonium bromide (CATB) and graphene oxide (GO) in water. We have developed a series of phase diagrams for the CTAB/GO/water ternary LC with independently varying CTAB and GO loadings covering various combinations of the isotropic and the different lyotropic phases of each, that occur as a function of concentration and temperature. The corresponding LLC microstructures are identified through polarised optical microscopy (POM) in a confined environment. We find that GO either promotes or suppresses the formation of the different lyotropic LLC phases of CTAB depending on the concentration of GO (whether the GO itself is in isotropic or lyotropic phase), resulting in the formation of a hybrid system. GO also significantly depresses the melting point of CTAB. Further rheological characterisation of the CTAB/GO/water systems demonstrates a reinforcement effect of GO sheets through forming CTAB/GO complexes and affecting the hexagonal LLC nanostructure. Our work reveals the diversity of effects on molecular LLC phases by an interpenetrating mineral LC phase, and the potential to design a wide range of novel nanostructured molecular/graphene hybrid LLC materials.

References

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Figures

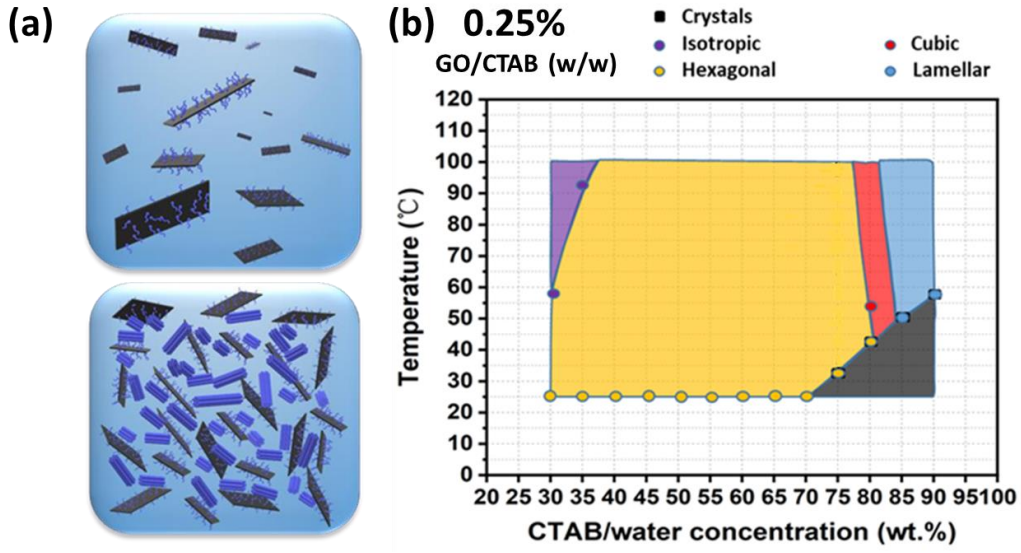

Figure 1: (a) GO sheets attached with CTAB molecules and hybrid structure of hexagonal phase of CTAB/GO LLCs; (b) phase diagram of CTAB/GO/water ternary LLC system.