Confinement of Graphene Oxide Layers

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Abstract

We study the insertion of GO sheets into an anisotropic fluid matrix, a lamellar host phase of amphiphilic bilayers. The elastic properties of the host matrix have been studied, and the concentrated regime of the binary system (graphene oxide - water) explored. Results from literature already show the liquid crystal organization of GO layers in bulk water. Transitions from an isotropic to a nematic, and from a nematic to a lamellar-like phase are observed when the GO mass fraction on the dispersion is increased.[1-4]

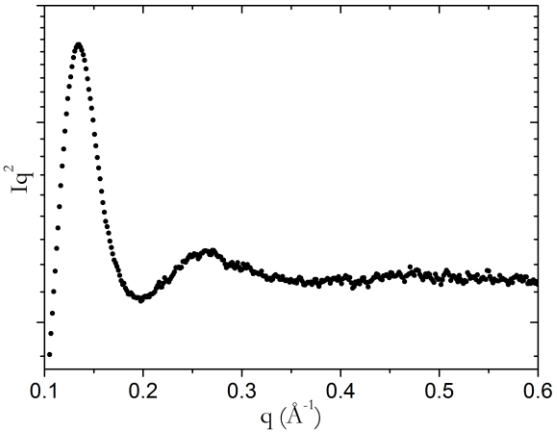

Fig. 1. Small-angle X-ray spectrum of a very concentrated GO and water dispersion.

One of the main experimental challenges of studying this binary system is to obtain very concentrated GO dispersions. We used many methods, resulting in samples with the presence of aggregates in most of the time. However, using a different method (ultracentrifugation), it was possible to obtain liquid-crystalline dispersions with concentration of around 20 percent of GO in mass, with no aggregates and smaller lamellar periods than the ones previously found in literature (around 5 nm), as can be seen from the x-ray spectrum shown in figure 1. Other methods are in development to obtain even more concentrated GO dispersions and these results should improve the dilution curve of GO dispersions and give a more reliable value for the GO monolayer thickness.

We then focused on the ternary system (graphene oxide - water - amphiphilic molecules). We can observe the formation of lamellar phases and, comparing with the systems composed of just amphiphilic molecules and water, our results show that GO sheets may enter the aqueous space between the bilayers, modifying their organization. It is possible to observe at least two different smectic phases for different compositions, with a region of coexistence. The phase diagram will be further explored and the different phases obtained characterized, using polarized light microscopy, dynamic light scattering and small angle x-ray scattering. This characterization should provide relevant information about a new material that could be used in many future applications.

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References

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