Lyotropic graphene oxide liquid crystal and its application

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Thanks to good affinity of hydroxyl and carboxyl groups on graphene oxide (GO) with water molecules, two dimensional GO flakes disperse well in water, giving rise to large negative zeta potential of an aqueous GO dispersion. Owing to the large aspect ratio of GO flakes, Onsager’s excluded volume theory predicts lyotropic nematic phase in the aqueous GO dispersion at quite low GO concentrations, which has been experimentally confirmed, recently.

Unlike other molecular liquid crystals (LCs), the lyotropic GO LC is difficult to achieve its alignment and electric-field induced switching. Considering that the easy control of alignment and the field-induced switching are the most important advantages of molecular LCs for various applications including LCDs, the aforementioned limitations of GO LC are critical for the potential applicability of GO based materials. Therefore, it is especially important to understand why GO LC behaves differently from other molecular LCs, and how to overcome these limitations, if any.

In this presentation, we clarify the underlying mechanisms for the difficulties in the GO LC alignment and field-induced switching. We also present a method to overcome the difficulties and demonstrate a nicely working electro-optic GO LC device and wide area uniform alignment. Interestingly, we found that GO LC itself has significant potentiality as an electro-optical application; that is, it has extremely large Kerr coefficient, several order larger than that of blue phase liquid crystals. This finding will be an important step for future applications of GO LC such as low voltage electro-optic devices using inorganic liquid crystal materials.

Fig. 1) Photos for a GO-LC device (left) and its electro-optic response (right)

References:

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