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Graphene Assisted Anchoring for Alignment of Nematic Liquid Crystal 5CB

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Abstract. Owing to the unique electronic properties, graphene can be used as electrodes as well as the aligning layers in liquid crystal (LC) industry to improve the operation of the LC devices as well as to induce new useful effects. We studied the effect of graphene single layers on the alignment of the room-temperature nematic liquid crystal (LC) pentylcyanobiphenyl (5CB). In this case, the single layer graphene nanostructure can interact with the LC benzene rings through $\pi-\pi$ stacking [1]. Monolayer graphene films (growth method: CVD synthesis) on copper substrates (18 μm-thick foils) were examined. LC cells of thickness 50 μm were assembled from these layered structures and glass slides coated with conducting nanolayers of indium-tin-oxide (ITO) overcoated with a polyimide alignment layer. The effect from the monolayer graphene is elucidated in details by polarizing optical microscopy and dielectric spectroscopy.

By our LC asymmetric cells with graphene on the one of their boundary surfaces, a clear effect of the graphene monolayer on the alignment of the nematic 5CB at the graphene surface was observed. In particular, by polarizing microscopy in reflection mode one can see that the monolayer graphene imposes a planar alignment on the nematic 5CB. As evidence it was demonstrated that between two crossed polarizers dark and bright states are achieved by LC cell rotation. As known, when the nematic director is parallel to anyone of both polarizers a dark state is achieved. When the nematic director is at 45° with respect to the polarizers, a bright state of maximum intensity appears. By dielectric spectroscopy we compared the alignment effect of the monolayer graphene on the nematic LC 5CB with the alignment by the same single-layer graphene film on a copper substrate but with a 100 nm-thick poly(methyl methacrylate) coating on the top of the graphene (in cells with identical thickness of 50 μm).

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