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Effect of chain length alteration on the self-assembly of poly(ε-caprolactone) functionalized graphene quantum dots

In spite of their multifarious applications, graphene quantum dots (GQDs) necessitate surface modifications to enhance their solution processability. To alleviate the problem, we have synthesized four poly(ε-caprolactone) (PCL) functionalized GQDs (S1-S4) with different degrees of polymerization (3, 7, 15 and 21) of PCL using ring opening polymerization. The as synthesized materials show self-assembly behavior in chloroform producing green emitting gels. Optical and morphological studies unveil the transformation of the assemblies from J-aggregates to H-aggregates, accompanied by alteration in morphology from toroid (S1) to spheroid (S2) to rod like (S3, S4) structures, with increase in chain length of PCL. Functionalized GQDs with lower chain lengths of PCL (S1 and S2) also assembles into liquid crystalline phases as observed from birefringent textures under a polarized optical microscope, which is later correlated to the formation of columnar hexagonal (Colh) mesophases. However, no such behavior is observed at higher chain lengths of PCL under identical conditions. So, it is obvious that variation of PCL chain length plays a crucial role in the self-assembly, which is primarily triggered by the van der Waals force acting between the polymer chains which dictates the π-stacking of GQDs, resulting in different self-aggregated behavior.

Preferred topic

Gels and nanoparticles

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