Magnetically-induced alignment of graphene via Landau diamagnetism

Bo Tian

King Abdullah University of Science and Technology (KAUST), Thuwal 23955-6900, Saudi Arabia

Bo.tian@kaust.edu.sa

Abstract

Maneuvering the alignment of graphene nanoplatelets has been regarded as a formidable challenge. Meanwhile, Landau diamagnetism (LDM), which is capable of inducing anti-magnetic forces, typifies an attractive maneuvering mechanism, but has not been applied in practice.

Here we have experimentally discovered that the LDM prevails in graphene nanoplatelets, and have further taken advantage of this mechanism to accomplish the alignment of graphene nanoplatelets in the N-methyl-pyrrolidone solvent under an external nonzero-gradient magnetic field. During experiments, we manipulate orientation angles and rates of graphene nanoplatelets via adjusting strengths of magnetic fields, and confirm such nanoplatelets' behaviors by means of laser-light-transmittance variations of the graphene colloid. Based on aforementioned mechanisms and experiments, we further fabricate a type of colloidal-graphene anisotropic materials for optical, thermal, and electrical applications.

Our findings help develop future capabilities of maneuvering graphene's alignments in order to manufacture novel graphene-based isotropic materials.

References

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Figures

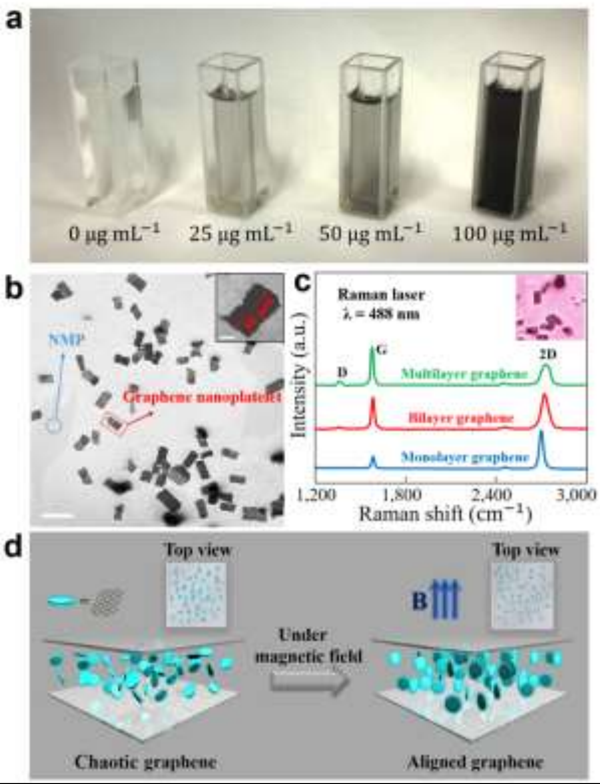

Figure 1: Optical and electron microscopies of graphene colloid and schematics of graphene alignment under external magnetic fields. (a) Graphene colloid (b) SEM image of graphene nanoplatelets (c) Raman spectra of graphene (d) Schematic of contrasting states of graphene nanoplatelets in NMP.