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Formation and control of band-gap in graphene by using low energy alkali metal ions

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Despite its superb electronic properties over other materials, graphene still remains as a tantalizing candidate to be actively utilized in electronic applications mainly because of its linear gapless band spectrum. Since the massless Dirac fermions in graphene showing ballistic charge transport even at room temperature are ideal charge carriers for fast circuit devices. Extensive research efforts have been made to open a tunable band gap in graphene with several different schemes. In this talk, we introduce a new scheme of forming and fine-tuning a band gap for a range suitable for most applications by using slow alkali metal ions mostly focused on Cs+ ions. We also demonstrate the on-off switching capability by controlling the size and mid-gap energy (or Dirac point) of the band gap independently by adding other neutral atoms. Our density-functional theory calculations for the π-band suggest that the sublattice asymmetry enhanced by the doped ions drives the behavior of the ion-induced band gap in graphene. This tunable alkali metal ion-induced band gap in graphene illustrates its potential application in future graphene-based nano-electronics.

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Lessons from nature for designing artificial light-harvester

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The structure of photosynthetic light-harvester is examined from classical electrodynamics point of view. We can explain from our model the reason of the modular design of nature, the cross-section of the light harvester must be elliptical instead of circular, the shape must be cylinder instead of a ball, the function of the notch at the light-harvester, the non-heme iron at the reaction center, the chlorophylls must be dielectric instead of conductor, a mechanism to prevent damages from excess sunlight, which consists of the physical requirement. We learnt from nature for designing artificial light-harvester.

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