Optical spectroscopy of nonplanar graphene nanoribbons with Fjord edges

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The band structure of graphene and its zero-gap at the K point of the first Brillouin zone lead to unique physical and electronic properties owing it to be used as an emerging material for many applications such as fast electronics, ultra-sensitive sensors, etc.. Nevertheless, the semimetal property in graphene constitutes a severe limitation for this material to be used in light harvesting devices. For that, various strategies have been investigated in order to open a gap in the electronic structure of graphene.

The carbon atoms in graphene are assembled in a 2D network of honeycombed hexagons. The reduction of the dimensionality of a single graphene layer in the form of a 1D graphene nanoribbons (GNR) or 0D graphene quantum dots (GQD) is a very promising method in order to open a significant gap (up to 1 eV). In this perspective, the electronic, optical, and spin properties can be controlled by designing the size, shape and edges of GNRs and GQDs. The fabrication of such nano-objects can be achieved for instance by the so called bottom-up chemistry approach, allowing to obtain a variety of desired structures with an atomic precision.

Bottom-up synthesized GNRs have been largely studied in order to understand their electronic and transport properties [1], while their fundamental optical properties are still unexplored. Here, we are interested by the study of intrinsic optical properties of GNRs. Recently, the synthesis of Fjord-GNRs, whose Fjord-edges are highly twisted, have been reported [2].
The photoluminescence spectra measured on ensemble of Fjord-GNRs in solution shows a broad band emission centered around 680 nm, which is interesting for optoelectronic devices. In order to investigate close-to intrinsic properties of Fjord-GNRs, we performed experiments at the single particle level using a confocal microscopy setup allowing us to study the emission process of a single Fjord-GNR. In this presentation we will show aspects of the photo-physics of a single Fjord-GNR [3].

References

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