OPTICAL INVESTIGATION OF C96 GRAPHENE QUANTUM DOTS

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2D graphene has established itself as an essential material in nanoelectronics thanks to its unique physical and electronic properties but suffers from an incompatibility for semiconductor applications due to its gapless electronic band structure. In this context, graphene quantum dots (GQDs), nano-pieces of graphene with a non-zero gap, is a fertile playground for controlled tunability of electronic properties. Bottom-up synthesis has enabled a precise control of the size, shape and edges of these objects, a crucial step towards the controlled engineering of their electronic properties [1]. Room-temperature experiments at the single-object level on a C_{96} triangular GQD (Fig. 1) have demonstrated bright and stable single-photon emission [2], giving promising prospects for its use as a quantum emitter at room-temperature.

Nevertheless, the fully unleash the potential of GQDs, important work remains ahead to understand their photophysics deeply. For example, theoretical calculations recently revealed that the fluorescence might arise from a symmetry-breaking of the GQD via vibrational deformations of the molecule, enabling appreciable emission from dark states [3]. In the perspective of unraveling the vibrational modes of the molecule, we performed low-temperature single-molecule experiments on the C_{96} GQD. By providing spectral resolution via spectral line-narrowing as shown in Fig. 2, this allows us to identify vibrational modes of the GQD. We thus discussed the nature of these modes and compared to theoretical predictions [4]. These results not only represent an important step towards deep understanding of the photophysics of GQDs, but also deliver new tools to unambiguously identify these objects for single-molecule experiments.

References
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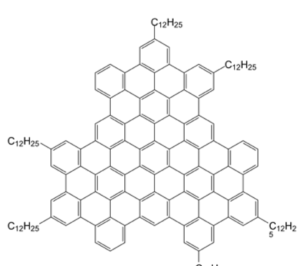

Figure 1: Chemical structure of C96 GQD.

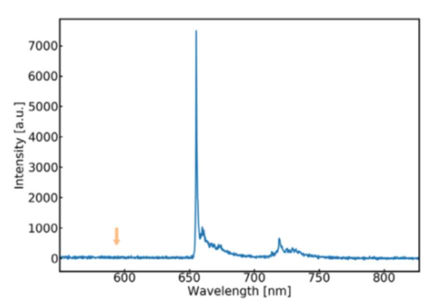

Figure 2: Low-temperature (7K) spectrum of C96 GQD (excited at 594nm).

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