Bottom-up synthesis and properties of rod-shaped graphene quantum dots

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For the last fifteen years, researchers have been interested in the synthesis and properties of graphene materials produced using a method called top-down. In 2008, H. Dai has been demonstrated the formation of graphene quantum dots (GQDs) starting from graphite material.[1] Nevertheless, this method does not allow controlling the structure of the final material at the atomic level. This degree of control is done by a simple method called bottom-up which exploits the chemical synthesis. A benzene ring is the ideal precursor for this approach and the multiplication of these rings forms polycyclic aromatic hydrocarbons (PAHs). The group of K. Müllen has developed a method for the synthesis of polyphenylene dendrimers based on the Diels-Alder reaction. These dendrimers are then oxidized by the Scholl reaction and give PAHs.[2] GQDs have a very low solubility in organic solvents. Optical analyses are tricky because of the molecules that aggregate strongly due to π-π stacking interactions and are therefore not individualized.[3]
To remedy this problem, functionalization of the edges of GQDs is possible to increase the steric hindrance of each GQDs, thus limiting π-stacking.[4-5] The new family of GQDs synthesized is "saturated" with tert-Butyl group that makes them highly soluble and individualized in classical solvents.

References

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Figures

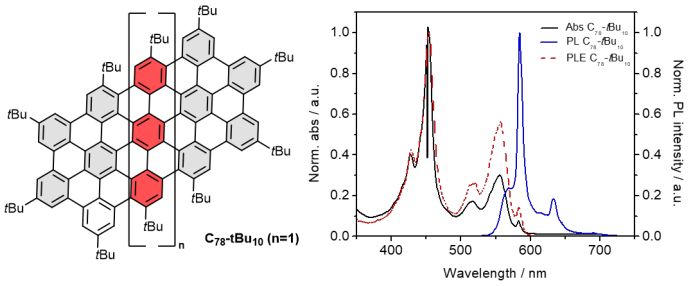

Figure 1: Structure and photophysics of a C78-tBu10 graphene quantum dots structures