

# Bottom-up Solution Synthesis of Graphene Nanoribbons

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Graphene nanoribbons (GNRs) have attracted great attention as their unique optical, electronic, and magnetic properties. However, the poor liquid-phase dispersibility of the GNRs resulting from the strong  $\pi$ - $\pi$  interactions impedes their investigation in a wide range of research areas. Among a number of preparation approaches of GNRs, bottom-up solution synthesis shows incomparable advantages in achieving precise structural control, large scale production, and organic functionalization of GNRs. What's more, solution synthesis can offer good solution dispersibility of GNRs by functionalization with polymeric side chains or long soluble chain which can widely broaden GNR-related studies on physicochemical properties and potential applications.

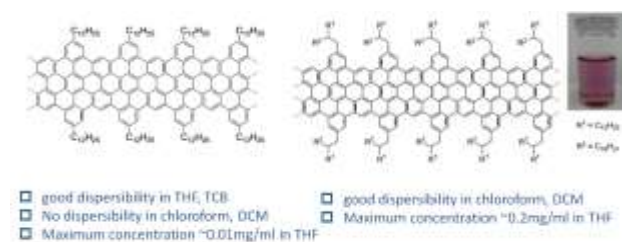
In 2013, Narita et al.<sup>[1]</sup> synthesized liquid-phase-processable GNRs that comprises linear and branched alkyl chains via a bottom-up solution-based strategy (Figure 1). The alkyl chains in those GNRs alleviate the  $\pi$ - $\pi$  stacking and hence the aggregation.

In 2016, Huang et al.<sup>[2] [3]</sup> synthesized GNRs with solution processability via a bottom-up strategy, where they have obtained excellent dispersibility in common organic solvents ( $\sim 1.0$  mg/ml in THF) and in water ( $\sim 0.5$ mg/ml) (Figure 2).

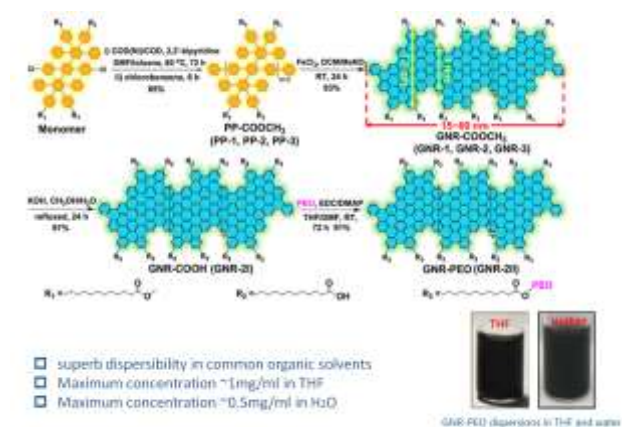
## References

- [1] Narita A, Feng X, et al., Nature Chem.,6 (2014) 126-132
- [2] Huang Y, Mai Y, Feng X, et al., J. Am. Chem. Soc., 138 (2016) 10136-10139.
- [3] Huang Y, Mai Y, Feng X, et al., Angew. Chem. Int. Ed., 57 (2018) 3366-3371.

## Figures



**Figure 1:** GNRs with linear and branched alkyl chain which realize the liquid-phase-processability of GNRs.



**Figure 2:** GNRs functionalized with poly(ethylene oxide) (PEO) chain with different molecular weights which have excellent solution dispersibility.