Processing of Epoxy/Graphene Nanocomposites

Jiacheng Wei, Thuc Vo, Fawad Inam

Northumbria University, Faculty of Engineering and Environment, Newcastle upon Tyne NE1 8ST, United Kingdom

Email: fawad.inam@northumbria.ac.uk

Introduction

Graphene can significantly improve physical properties of epoxy at extremely low loading when incorporated appropriately. However, in practical terms, graphene is not suitable to disperse in epoxy just by simple mixing, which is due to graphene's pronounced tendency to reaggregate in the matrix due to the strong van der Waals force between separately dispersed graphene sheets. In order to substitute traditional epoxy reinforcements with graphene, there are still some issues like dispersion, homogenization, and reaggregation. Therefore, the preparation of epoxy/graphene nanocomposites affects strongly to the final properties of nanocomposites.

In this work, graphene bundles have been dispersed in two-component epoxy system by bath sonication. Dispersion state and reaggregation behavior of graphene in this system have been studied. Light transmittance in ultraviolet-visible spectroscopy has been used to quantify the reaggregation by a series of controlled experiments.

Experimental

- Graphene dispersed in epoxy(EP) / hardener(HD) respectively by hand mixing for 5 s gently and then sonicated through bath sonicator.
- The effect of different sonication time, different storage time, different graphene concentration, and different sonication temperature have been studied.
- To prepare nanocomposites, graphene was first dispersed in hardener by bath sonication. Then mixed with liquid epoxy following thorough hand mixing for 10 mins.

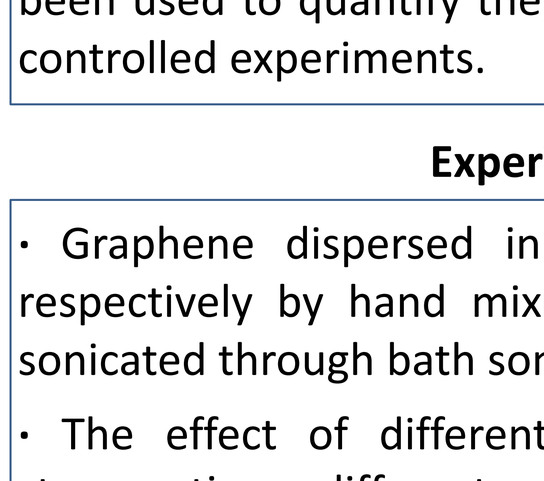

Fig 1. SEM image of graphene

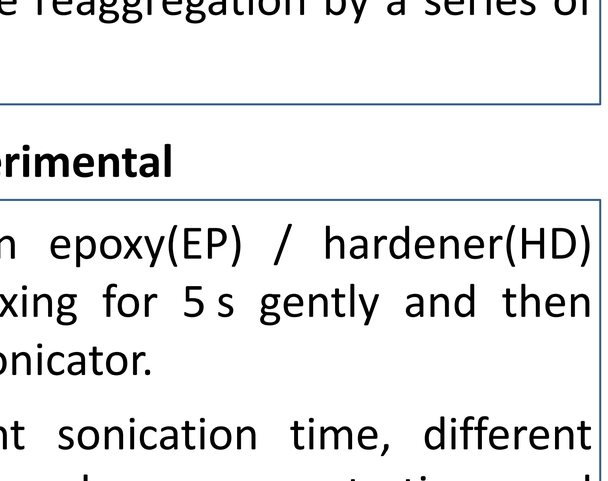

Fig 2. Graphene dispersion in different concentration

Results and Discussion

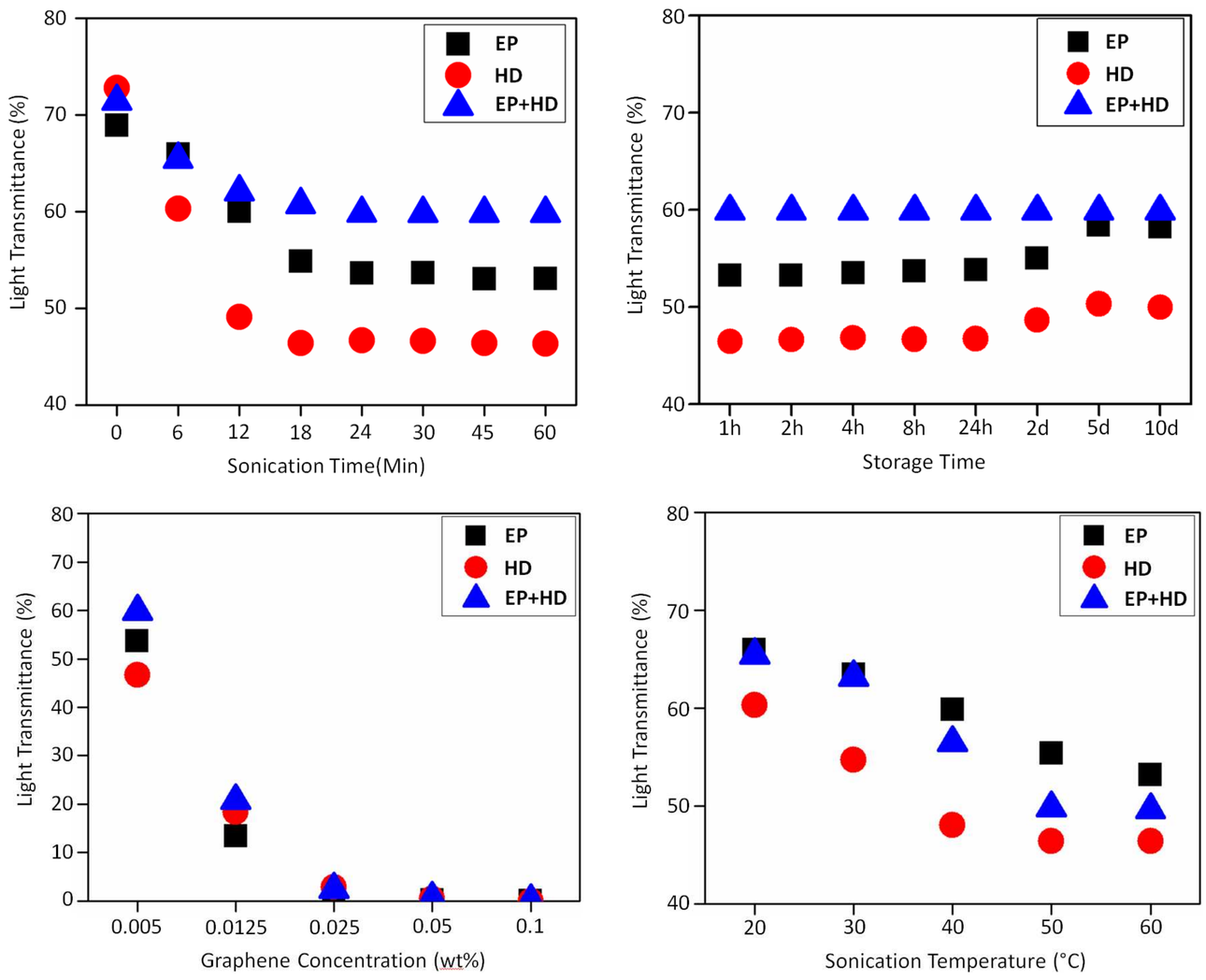

Fig 3. Using light transmittance to characterize the dispersion in liquids

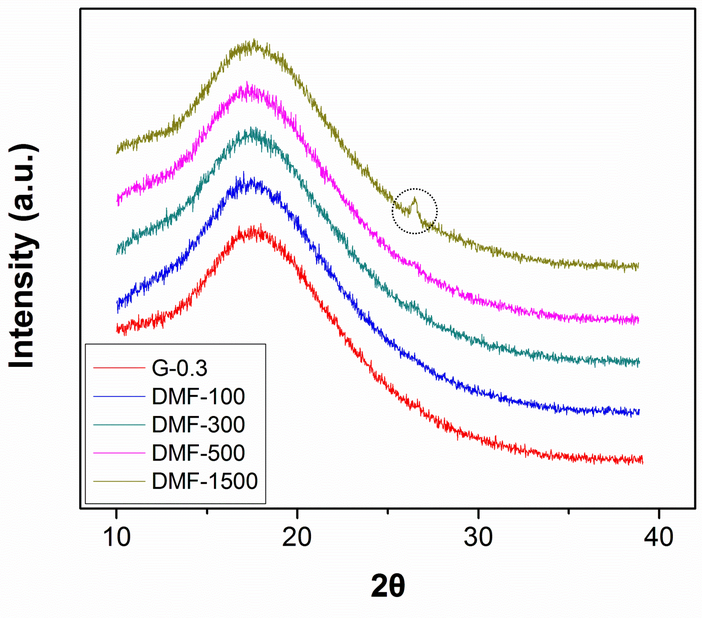

Fig 4. Using XRD to test the dispersion in composites

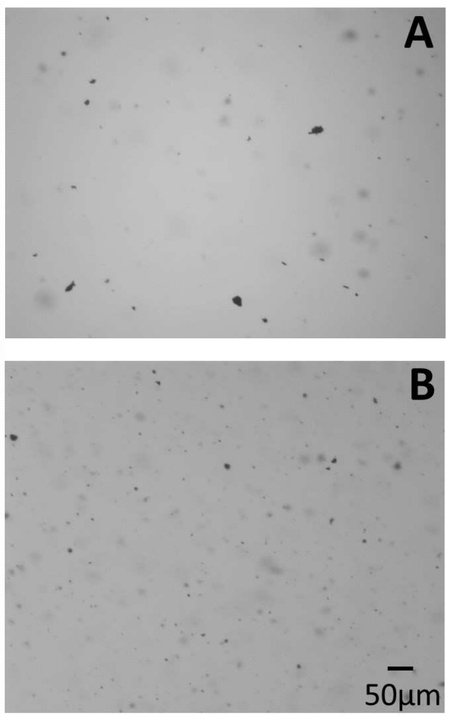

Fig 5. Graphene dispersion before/after sonication

Conclusions

- The more uniformly dispersed, the more light absorption.
- 18mins sonication is good to disperse graphene in epoxy system.
- No obvious aggregation happens during 10days storage.
- Reaggregation is more pronounced at higher concentration.
- The higher sonication temperature is, the easier to disperse.
- Viscosity significantly contribute to the dispersion

References

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2. J Wei, T Vo, and F Inam. Epoxy/graphene nanocomposites–processing and properties: a review. *RSC Advances* 5.90 (2015): 73510-73524.

Acknowledgements

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