Lyotropic Liquid Crystal of Polyacrylonitrile-Grafted Graphene Oxide and Its Assembled Continuous Strong Nacre-mimetic Fibers

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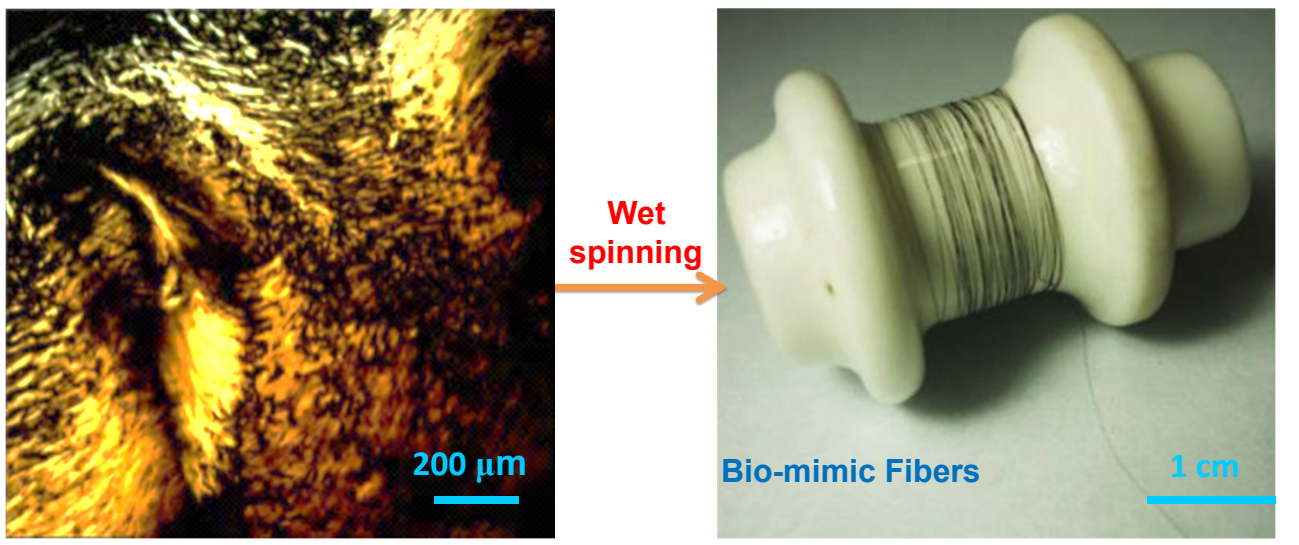
Introduction

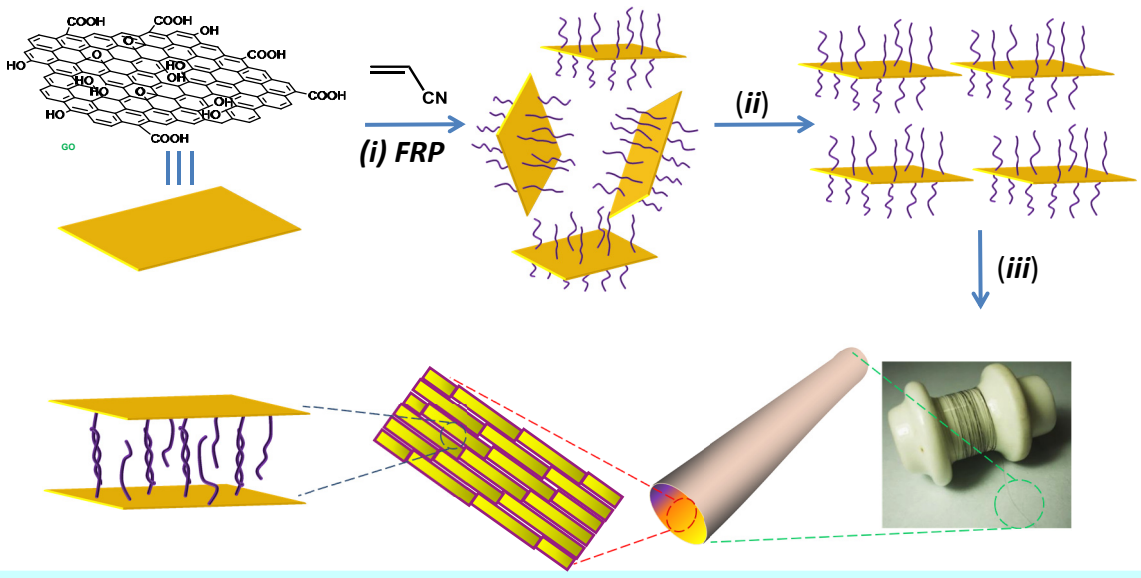
The chiral liquid crystal (CLC) phase of pristine graphene oxide (GO) have been disclosed recently, opening an avenue to high performance neat graphene fibers. Here, we report for the first time LC of polymer-grafted GO and its macroscopic assembled nacre-mimetic composite.

Polyacrylonitrile (PAN) grafted GO (GO-*g*-PAN) were obtained *via* a simple free radical polymerization process. Macroscopic assembled fibers were continuously spun from the GO-*g*-PAN LCs via the industrially viable wet-spinning technology.

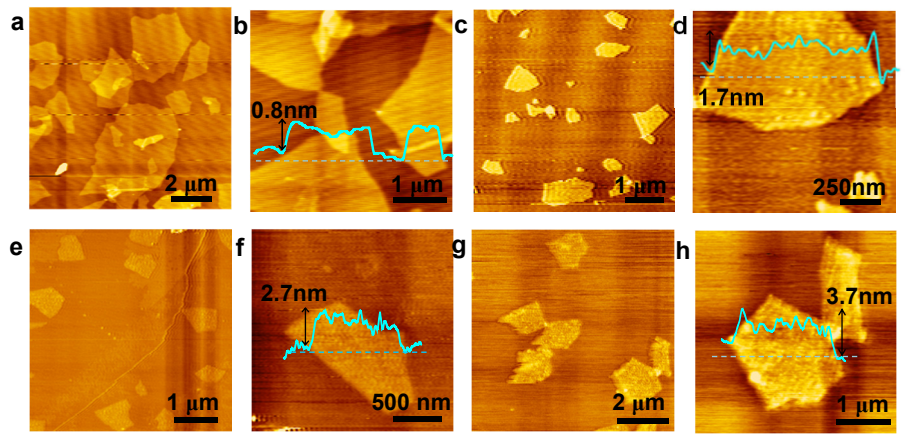
The nacre-mimetic composite fibers showed excellent mechanical property with tensile strength of 452 MPa, Young's modulus of 8.31 GPa, and breakage elongation of 5.44%. This offers a new approach for the fabrication of continuous, ultrastrong and tough bio-mimic composites.



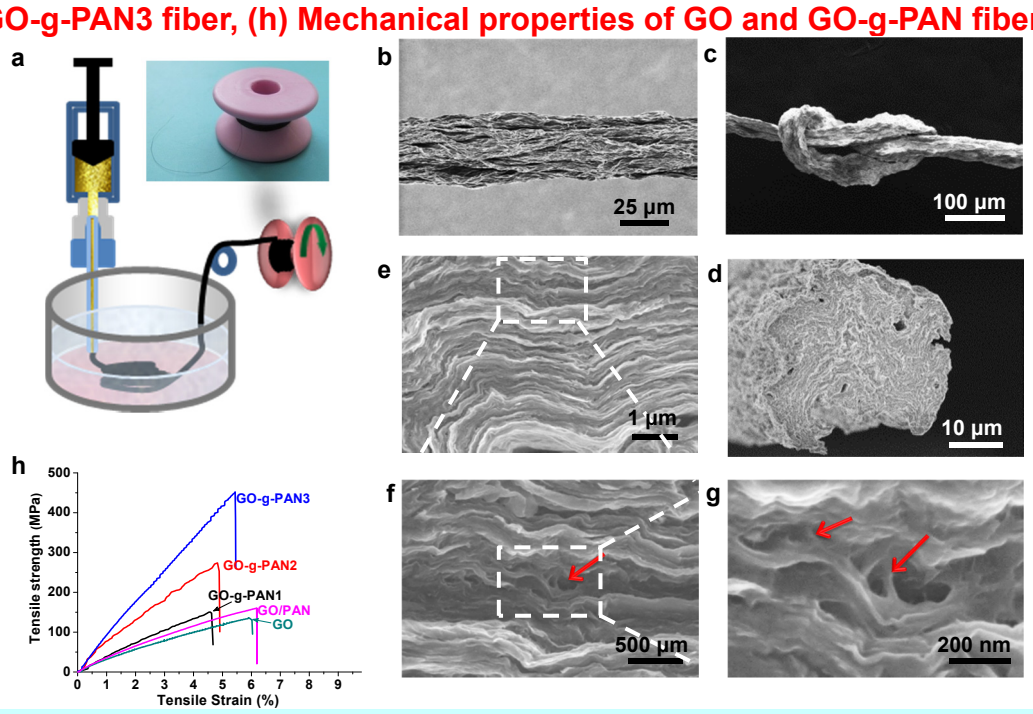
Schematic protocol to synthesize GO-*g*-PAN and make bio-mimetic fibers.



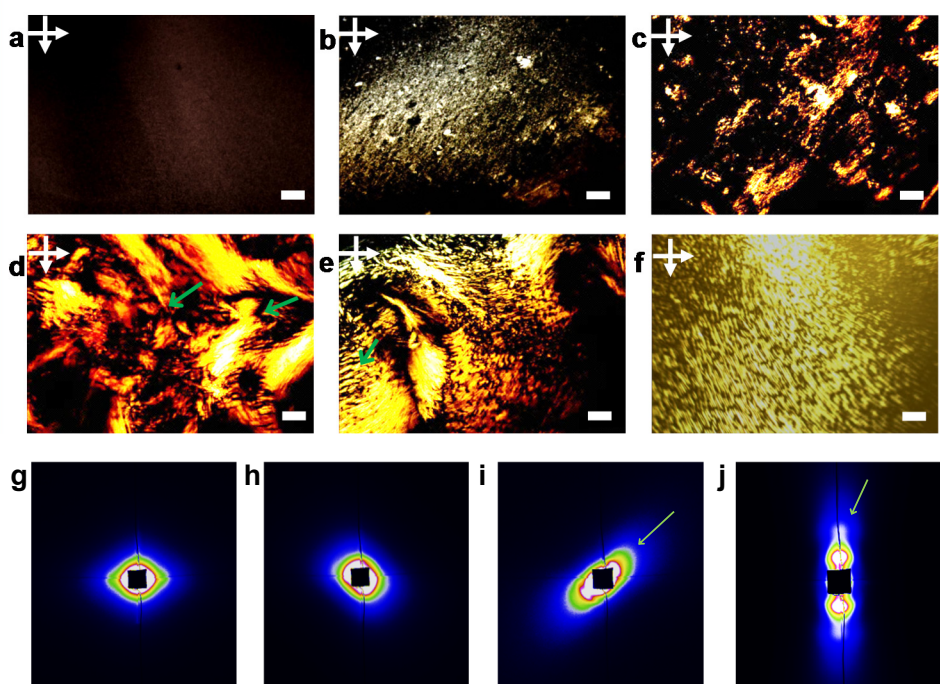
AFM images of (a, b) pristine GO, and (c-h) GO-*g*-PANs with different grafted polymer thickness.



Schematic apparatus for spinning GO-g-PAN fibers (a). SEM images of the surface winkled (b),the knot (c) and the section morphology (d~g) of GO-g-PAN3 fiber, (h) Mechanical properties of GO and GO-g-PAN fibers



The evolution of LCs characterized by POM between crossed polarizers (a-f) and SAXS measurements



References and notes

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Conclusion

In conclusion, we synthesized PAN-grafted GO (GO-*g*-PAN) and discovered its helical lamellar liquid phase. The realization of continuous strong bio-mimetic fibers breaks new ground for the design and preparation of bio-mimics and high performance composites by introduction of covalent grafting to the inorganic and organic interfaces.

Acknowledgements

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